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NATURE, HISTORY, CAUSES, AND TREATMENT;

WITH A REVIEW OF

THE PREVAILING THEORIES AND PRACTICE OF
THE MEDICAL PROFESSION;

ALSO,

A DELINEATION OF THE NEW

CHLORAL HYDRATE

Method of Treating the Same; Its Superior Success,

AND ITS TITLE TO BE CONSIDERED

A SPECIFIC.

BY

C. B. GALENTIN, M. D.

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PREFACE.

Whoever adds a new book to the long catalogue of medical works, should have something to say which has either not been well said before, or that is new. On the subjects treated in this volume much has been well said and written by men in the profession, eminent as writers and teachers. In history, ætiology and pathology, it can be truthfully said, they have constructed an almost faultless edifice, wanting only a therapeutic finish to complete the fabric. On this latter only has the writer anything very important or new to contribute. On the therapeutics of diphtheria so indefinite and diverse have been the opinions of the architects, that the laborious student is more dazed than edified, by being conducted into voluble labyrinths that end in the confusion of uncertainty and doubt. "Systematic feeding," and direction to "treat the symptoms as they arise," is nearly the sum of what has been developed in the medical treatment of diphtheria.

The writer has been led, or driven, into a new and hitherto untried field of therapeutics in this destructive disease, and for several years, in the treatment of hundreds of cases, has demonstrated to his entire satisfaction the claims of *Chloral Hydrate* to specific efficacy in the membranous diseases, diphtheria, croup, &c. It is expected that this announcement will be received with reserve and a measure of incredulity, even by men of fair minds and culture; by others possibly with positive contradiction and opposition, and by another too numerous class of pompous, opinionated and bigoted men, or doctors, if you please, with derision. These latter are the obstructionists of progress, ever ready to sneer at, and strive to detract from the influence of any discovery in medicine so unfortunate as not to have been developed beneath their own hats. However it *may* be received by the profession, it is confidently believed that it will be sustained by experience, and will *stand*, as have other truths, upon its own merits.

Other practitioners of ripe age and large experience, both in this city and elsewhere, at the suggestion of the writer, have tested the efficacy of chloral in a very large number of cases of diphtheria, and unhesitatingly affirm its efficacy, as superior to any other known treatment.

Among these I mention with pleasure my esteemed and scholarly friend, Dr. A. G. Hart, and my daughter and co-laborer in this work, to whom its merits, if any be accorded it, are largely due. Finally, to those whose lives and labors are honestly devoted to the true interests of the noble profession of medicine, and the welfare of humanity, I wish to say,

GENTLEMEN, the writer submits whatever is new and useful in this little volume to YOU, for your careful consideration and use; in the pleasing hope of rendering both to you, and through you, to the world, a tittle of the good service we owe each other and humanity, with a humilitating sense of its many defects.

C. B. G.

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INTRODUCTION.

The treatment of different diseases by similar remedies, as advocated in the following pages, to thoughtful practitioners will appear neither strange nor unreasonable. Diseases differing widely in their essential characters, are not infrequently related by symptoms or phenomena that are common to several.

The entire system of the so-called "Rational treatment of disease," indeed, *consists* in the treatment of the symptoms as they arise, if we except only the few instances in which the treatment is specific. Pain in the chest for example, may be occasioned by a variety of diseases, as pneumonia, pleurisy, and neuralgia, but regardless of its cause, requires anodynes for its cure. Hemorrhage, whether from the lungs, the stomach, the uterus, or the bowels, depending on different organic or general diseases, calls alike for gallic acid, ergot, and the like. An exhausting diarrhœa occurs in quite opposite states and may be very properly controlled by opium, etc., regardless of the particular disease; sleeplessness, occasioned by very diverse causes, calls alike for chloral, morphia, etc.; debility, regardless of its cause, is treated properly with nutrients and restoratives; and an exalted temperature of the body, whether inflammatory or typhoid, with antipyretics. *Symptoms*, and not the *names* of diseases, are treated by intelligent practitioners, with the exception of those treated by specifics as before stated.

In the diseases which we call Membranous, and which only are the subjects of this volume, we observe a common diagnostic symptom or manifestation. It is not pain, nor diarrhœa, nor hemorrhage, nor hyperpyrexia, nor debility, but a peculiar *exudation* from the blood, generally upon mucous surfaces, denominated false membranes. These membranes are so nearly identical in structure and materials as to render a distinction nearly or quite impossible.

As we shall have occasion hereafter to note, their appearance has been attributed to both local and general causes, which are possibly so obscure, remote, or ethereal, as forever to elude discovery. What we wish here to observe is, simply that these diseases, having a like prominent and diagnostic symptom, may *rationally* be treated by the same or similar remedies without the violation of any principle entitled to professional respect.

It is but reasonable to infer, from the identity of these plastic exudates, that some similar systemic disturbance exists in each of these diseases; and yet this is only inferential. Many regard croup and plastic bronchitis as purely of local origin from the lack of early constitutional symptoms; while others, equally honest and intelligent, observe that common acute inflammation in the same localities is not *ordinarily* attended by the membranous exudation, and therefore conclude that in these, as in diphtheria, there probably exists *primarily* some peculiar toxæmia.

Neither of these theories is thought to be entitled to, or should be given, any particular influence by the practitioner in deciding upon his therapeutical measures at the bedside, and hence they are dismissed for the present without discussion for matters of a more practical nature.

AUTHOR.

DIPHTHERIA.

CHAPTER I.

DEFINITION.

Diphtheria is an acute, specific, contagious, febrile disease, which occurs epidemically, endemically and sporadically, in most countries of the world, and is characterized by general or constitutional symptoms like other pyrexial diseases, with a greater or less degree of inflammation of the mucous membrane of the pharynx, larynx, air passages, or other mucous passages; and by the formation on the surfaces of these parts, particularly upon the mucous membrane of the pharynx and upper air passages, of a lympho-fibrinous membrane, generally in patches of a whitish, yellowish, or grayish color.

It is further characterized by more or less inflammatory swelling of the glands of the throat and neck or *adenitis*.

During the prevalence of diphtheria, wounded, abraded, or ulcerated surfaces, upon any part of the body, frequently become covered with a membranous deposit similar to that in the more ordinary situations. The constitutional symptoms usually denote a depressed state of the vital powers. Often the urine becomes albuminous from renal disturbance. The sequelæ most common are lesions of the nervous system causing a greater or less degree of paralysis, impairing in proportion, phonation, deglutition, respiration, sensation, etc. Fatal cases usually terminate by gradual apnea; less freqently by asthenia and cardiac thrombosis.

CHAPTER II.

NOMENCLATURE.

The term *diphtheria* is of Greek origin, and may properly be defined by the English term *membrane*. *Diphtheria*, *diphtherite*, and *diphtheritis* are all used as synonyms, and have the same origin.

Diphtherite, as applied to the disease under consideration, was originally employed by M. Bretonnau, a celebrated French physician, in his work entitled "Traite de la Diphtherite," published in Paris in 1826. Trousseau, considering the term objectionable because of the termination *ite*, used in medical science to imply inflammation, changed the word to *diphtherie*, in order to get rid of the aetiological doctrine of inflammation expressed by the suffix; and, technically speaking, *diphtheria* is the English synonym of the French *diphtherie*.

Among ancient writers the disease received a varity of apellations, as; *ulcus Egyptianum vel Syriacum* — the Egyptian or Syriac ulcer; *angina gangrenosa* — gangrenous sore throat; *morbus suffocans vel strangulatorius* — suffocating or strangulating sickness; *garotillo* — throat disease; *angina suffocativa* — suffocating sore throat; *malum canna* — throat sickness; and many others.

CHAPTER III.

HISTORY.

(COMPILED FROM THE BEST AUTHORS.)

It is not the purpose of the writer, nor within the scope of the present volume to enter exhaustively into the bibliography of diphtheria. This alone would fill a volume, and could not be made profitable to the laborious practitioner of medicine, for whom alone, in the interests of humanity, this treatise is designed. The following epitome of what is known on the subject is derived from a careful study of the best authorities, and may be regarded as authentic.

Diphtheria, or throat affections in some respects analagous to it, can be traced to a remote antiquity ; their identity with the modern disease is, however, often only imaginary, or inferred from the resemblance of a few symptoms. There are no proofs of any epidemic prevalence of the disease as it is seen at the present time, until about the middle of the eighteenth century.

Among the more ancient medical records quoted by writers in proof that the ancients were acquainted with this affection are the following. Nearly twenty-five hundred years ago, or about the time of Pythagoras, an East Indian physician, named D'hanvantare, gave a description of a disease, thought by some to have been diphtheria, in which "An increase of phlegm and blood causes a swelling in the throat, characterized by panting and pain, destroying the vital organs, and incurable : — a large swelling in the throat impeding food and drink, and marked by violent feverish symptoms, obstructing the passage of the breath, arising from phlegm combined with blood, is called closing of the throat."

Galen of Pergamos, about the middle of the second century, speaks of a membranous formation in the pharynx being ejected by expectoration. Aretæus of Cappadocia, a physician of renown who practiced at Rome about the time of Augustus, has left a history of the Egyptian or Syriac ulcer, considered to have more points of resemblance to the diphtheria of to-day than any other disease of antiquity. This was characterized by ulcers on the tonsils, some mild and harmless, while others were pestilential and fatal. "The former, which are common — are clean, small, and superficial, and are unaccompanied by either pain or inflammation. The latter, which are rare — are extensive, deep, putrid, and covered with white, livid, or blackish concretion. —— If it extends rapidly to the chest through the windpipe, the patient dies on the same day by suffocation.

Cœlius Aurelianus, writing about the close of the third century, "describes the barking sound of the voice and its occasional complete extinction, the stridulous breathing, and lividity of the face. His reference to the defective articulation sometimes present, and to the passage of fluids into the nose in swallowing, probably refer to the paralytic symptoms of the disease. It is supposed by some that the Askara frequently mentioned in the Talmud as a fatal epidemic, was, in fact, diphtheria. Rashi, the learned commentator of the Talmud and Old Testament, remarks with reference to the Askara, that sometimes it breaks out in the mouth of a man and he dies from it. 'Also that sudden death ensues from suffocation.'" (Mackenzie.)

"Macrobius speaks of a similar epidemic at Rome, A. D. 380, during which, sacrifices were offered up to a certain Goddess — ut populus Romanus, morbo, qui angina dicitur promisso voto, sit liberatus." (Slade.) "Aetius, of Amida, in the sixth century delineated the disease as presenting white and ash-gray spots in the pharynx, slowly ending in ulceration." (Mackenzie.)

Brief and unsatisfactory as are the preceding quotations, they are believed to constitute the bulk and basis of the evidence extant that the ancients were acquainted with this malady. From the sixth to the latter part of the sixteenth century, nothing further in medical history is noted as having any very probable reference, or clear analogy to this disease. Hecker's accounts of the epidemics of the fourteeth, fifteenth, and sixteenth centuries, in Holland, France, and England some of them characterized by violent anginose affections, quoted by Slade to connect the ancient and modern records of the disease, must be considered irrelevant, and wanting in any recorded appearance or symptom characteristic of genuine diphtheria.

Of modern writers, Bailou, a distinguished French physician, whose writings bear the date 1576, is believed to be the first who makes distinct mention of a false membrane. In the early part of the 17th century an epidemic angina, denominated *garrotillo* prevailed in Spain. Its best description is by Villa Real, who states that he has seen "a thousand times, in patients at the first onset of the disease, a white matter in the fauces, gullet, and throat. He adds that the matter is of such nature, that if you stretch it with your hands it appears elastic, and has properties like those of wet leather — facts which he noticed, not only by observing the matter coughed up by the living, but also by the examination of it in the dead."

About the same period, accounts of the disease, less satisfactory because of the omission of the post-mortem appearances, were written by Herara and Fontecha. They, however, confirm the prevalence of garrotilla (diphtheria) in Spain between the years 1581 and 1611. The name "garrotillo" was first given the disease because those attacked by it perished as if strangled by a cord. In 1617 diphtheria was prevalent in an epidemic and fatal form at Naples and in other parts of Italy. (Sgambatus.) It was sometimes called "Male-de-canna" — disease of the trachea. It continued its ravages for a period of at least twenty years, and has been described by several other writers of authority, as, Carnevale, Zacutus Lusitanius, and Marcus Aurelius Severinus. "Carnevale in particular has given us full data of this epidemic in his treatise entitled 'de Epidemico Strangulatione Affectu.' The children were first attacked, the disease afterward spreading among the population generally, and proving very fatal. The disease commenced by mild inflammation of the throat; soon the affected parts presented a whitish exudation; the breath became fetid; deglutition impossible; the respiration embarassed, and the patient died of suffocation. This writer also gives us the different appearances which the pharynx presented in this epidemic; he also speaks of the extension of the disease to the trachea, æsophagus, and pituitary membrane;—of the diagnosis, prognosis, and the topical remedies, all of which are quite in accordance with modern views" (Slade). Carnevale also asserts its identity with the disease which had been prevailing in Spain under the name of garrotillo.

In 1625 the writings of Cortesius show that the same disease extended, a little later, to Sicily. He speaks of a membrane in the throat, which could readily be torn away, as being one of its characteristics. In 1632 Alaymus published a treatise upon the Syrian ulcer. He prefers this term, he says, inasmuch as it applies to all forms of the disease, which he describes in a manner similar to Carnevale. "In 1713 Dr. Patrick Blair, of London, in a letter to Dr. Mead, described a disease as 'the croops' which, he says, was epidemic and universal at Coupar Angus, and which was no doubt diphtheria." (Mackenzie).

From 1743 until 1748 the disease prevailed in Paris, and has been described by Malouin and Chomel. About the same date Ghisi describes an epidemic of the disease in Palermo, and noticed the paralytic sequelæ. Also about the same time a similar epidemic appeared both in England and at Cremona, accounts of which were given by Fothergill, Starr, and Ghisi. These epidemics were very destructive, especially in England, where it was regarded by Fothergill as scarlatina. He says, "If the mouth and throat be examined soon after the first attack, the uvula and tonsils are found swelled; and these parts, together with the velum-palati and pharynx, appear of a bright red color, which is most marked on the posterior edge of the palate, in the angles above the tonsils, and upon the tonsils themselves. Instead of redness, a broad spot or patch of an irregular form, and of pale white, is sometimes seen surrounded with florid red, which whiteness appears like that of the gums immediately after being pressed with the fingers, or as if matter ready to be discharged was contained beneath. Generally on the second day of the disease, the face, neck, hands, and breast, are of a deep erysipelatous color, with a sensible tumefaction. A great number of small pimples, of a color more intense than that which surrounds them, appear on the arms and other parts." (In a note he says, "The eruption and redness have not so regularly accompanied the disease during the latter part of this Winter, 1754, as they did last year. In some cases they did not appear at all, in others not till the third or fourth day.") "The appearances in the fauces continue the same, except that the white places become more ash-colored; and it is now found that what might have been taken for the superficial covering of a suppurated tumor, is really a slough, concealing an ulcer. Instead of the slough, in mild cases, a superficial ulcer, of an irregular form, appears in one or more parts, scarce to be distinguished from the sound, but by the irregularity of surface which it occasions. Towards night, heat and restlessness increase, and a peculiar kind of delirium comes on, the pulse is generally very quick; in some hard and small; in some soft and full. The tongue is generally moist, and not often found coated. In some it is covered with a thick white fur; and these generally complain of soreness about the root of the tongue." (Slade.)

"In 1749 Marteau de Grandvilliers described an outbreak of the disease in Paris, and the elder Chomel, in detailing the symptoms, accurately described diphtherial paralysis. In 1750 the formation of a membraniform concretion in the throat is distinctly described by Dr. Jno. Starr, as occurring as an epidemic in Cornwall, England." (Mackenzie.)

In 1757, Dr. Huxham in a treatise denominated "A Dissertation on the Malignant Ulcerous Sore Throat," described an epidemic which had been prevalent at Plymouth, in which some of the cases were undoubtedly of the character of secondary diphtheria. "Not only," says he, "were the nostrils, fauces, &c., affected, but the windpipe itself was much corroded, and pieces of its internal membrane were spit up."

"Dr. Starr, of Liskeard, published a paper in the *Philosophical transactions*, upon the malignant ulcerous sore throat epidemic which appeared in that place in 1749. In this paper, besides other details of the epidemic, he gives the full data of a case in which the false membrane commencing in the fauces, extended to the larynx. He particularly dwells upon the physical properties of the exudation, its adherence to the subjacent surface, its frequent detachment and reproduction. In fact, he gives a complete picture of Bretonnau's diphtheria."

In 1789, Dr. Samuel Bard of Philadelphia, in a work entitled, "Researches on the Nature, Causes, and Treatment of Suffocative Angina," gave a detailed account of "an uncommon and highly dangerous distemper" which had recently proved fatal to many children in New York. He recognized the analogy between this disease and croup, as well as the manner in which it spreads from the throat to the larynx. He observed it sometimes as simple angina; sometimes as angina complicated with laryngitis, and occasionally as laryngitis alone.

"In general the disease was limited to children under ten years of age, though some few grown persons, particularly women, had symptoms very similar to it. Most of the persons attacked were observed to droop before they were confined. Usually the first symptoms were a slightly inflamed eye, a livid countenance, and slight eruptions upon the face. At the same time, or very soon after, those who could speak complained of an uneasy sensation in the throat, but without much soreness or pain. Upon examination, the tonsils appeared swelled and highly inflamed, with a few white specks upon them, which, in some cases, increased so as to cover them all over with one general slough; this, however, although a frequent symptom, did not invariably attend the disease. The breath was not offensive, and deglutition but very little impeded.

"These symptoms continued in some cases for five or six days without creating any alarm; in others, a difficulty of breathing came on within twenty-four hours, especially during sleep, and was often suddenly increased to such an extent as to threaten immediate suffocation. Generally it came on later, increased more gradually, and was not constant.

"This stage of the disease was attended with a very great and sudden prostration of strength, a very peculiar, hollow, dry cough, and a remarkable change in the tone of the voice. In some the voice was almost entirely lost, and would continue very weak and low for several weeks after recovery. These symptoms continued for one, two, or three days, and greatly increased in those who died; purging in several cases came on, the difficulty of breathing became more marked, and the patient died apparently of suffocation. This commonly happened before the end of the fourth or fifth day. One child, however, lived under these circumstances to the eighth day. Shortly before he died, his breath and expectoration were somewhat offensive; but this was the only instance in which I could discover anything like a disagreeable smell, either from the breath or expectoration.

"In some cases instead of the difficulty in respiration, very troublesome ulcers appeared behind the ears.

"'These began with a few red pimples, which soon ran together, itched violently, and discharged a great deal of very sharp ichor, so as to erode the neighboring parts, and in a few days spread all over the back part of the ear, and down upon the neck.'

"In a few cases swelling of the parotid and sublingual glands was noticed. Dr. Bard says:—

"'I met with but two instances of anything like this complaint in adult persons. Both of these were women, and one of them had assisted in laying out two of the children that had died with it. At first her symptoms resembled rather an inflammatory angina; but, about the third day, the tonsils appeared covered in some places with sloughs: her pulse was low and feeble; she had a moist skin, a dejection of spirits, and some degree of anxiety, though nothing like the difficult breathing of the children.

"'The other was a soldier's wife; who, for some time, before she perceived any complaint in her throat, labored under a low fever. Her tonsils were swelled and inflamed, and covered with sloughs resembling those of the children; but her breath was more offensive, and she had no suffocation.

"'I have had an opportunity of examining the nature and seat of this disease from dissection in three instances. One was a child of three years old. Her first complaint was an uneasiness in her throat. Upon examining it, the tonsils appeared swelled and inflamed, with large white sloughs upon them, the edges of which were remarkably more red than the other parts of the throat. She had no great soreness in her throat, and could swallow with little or no difficulty. She complained of pain under the left breast; her pulse was quick, soft, and fluttering. The heat of the body was not very great, and her skin was moist; her face was swelled; she had a considerable prostration of strength, with a very great difficulty of breathing; a very remarkable hollow cough, and a peculiar change in the tone of her voice. She was exceedingly restless; was sensible, and when asked a question, would give a pertinent answer; but otherways, she appeared dull and comatose. All these symptoms continued or rather increased till the third night, on which she had five or six loose stools, and died early in the morning.

"'Upon examining the body—which was done on the afternoon of the day she died—I found the fauces, uvula, and root of the tongue interspersed with sloughs, which still retained their whitish color. Upon removing them, the parts underneath appeared rather pale than inflamed. I perceived no putrid smell from them, nor was the corpse in the least degree offensive. The æsophagus appeared as in a sound state. The epiglottis was a little inflamed on its external surface; and on the inner side, together with the inside of the whole larynx, was covered with the same tough white sloughs as the glands of the fauces. The whole trachea, from the larynx down to its division in the lungs, was lined with inspissated mucus, in form of a membrane, remarkably tough and firm; which, when it came to the first subdivisions of the trachea, seemed to grow thin and disappear. It was so tough as to require no inconsiderable force to tear it, and came out whole from the trachea, which it left with much ease; and resembled, more than anything, both in thickness and appearance, a sheath of thin chamois leather. The inner membrane of the trachea was slightly inflamed; the lungs, too, appeared inflamed, as in peripneumonic cases, particularly the right lobe, on which there were many large livid spots, though neither rotten nor offensive; and the left lobe had small black spots on it, resembling those marks left under the skin by gun-powder. Upon cutting into any of the larger spots which appeared on the right lobe, a bloody sanies issued from them without frothing.'"

"He supposed the prevalence of the epidemic to depend upon the state of the air or a peculiar miasm "which more or less, according to particular circumstances, generate an acrimony in the humors and dispose them to putrefaction; and which have a singular tendency to attack the throat and trachea, affecting the mucous glands of these parts in such a way as to occasion them to secrete their natural mucus in greater quantities than is sufficient for the purposes of nature, and which in this particular species, when secreted, is really either of a tougher or more viscid consistence than natural, or is disposed to become so from rest and stagnation."

Dr. Bard, says Mackenzie, was a careful and painstaking observer, and his monograph contributed very considerably to the accuracy of contemporary knowledge of diphtheria; to which we might truthfully add that it is the model after which have been constructed most of the descriptions of diphtheria which have since appeared, both in this country and in Europe.

In 1802 appeared the "First lines in the practice of Physic," by Dr. Cullen, professor of the practice of physic in the University of Edinburgh, in which, under the title "*cynanche trachealis,*" is to be found a description thought to be characteristic of the diphtheria of to-day.

In 1826 appeared the works of M. Bretonneau. These owed their origin to the alarming outbreak of the disease among the soldiers in the barracks at Tours in the latter part of 1818, spreading from thence to the surrounding country. In Tours most of the victims were children, and the larynx most frequently affected, while among the soldiers the gums were the favorite seat of the diphtheritic exudation. Bretonneau describes the disease in Tours as mild at the commencement, but becoming alarmingly severe in a few days, and very fatal. From thence it spread to two small villages adjoining, and thence throughout France. In some towns, remarkable for their salubrity and good sanitary conditions, it raged violently, while others situated in low marshy regions, almost entirely escaped. Elsewhere it seemed to select ill-drained localities, and pass over those in better sanitary conditions. As evidence of its virulence a case is mentioned in which out of seventeen persons in a single farmhouse, thirteen died of the disease.

In Edinburgh, in 1826, the disease prevailed as a fatal epidemic, and was accurately described as "diphtherite" by Dr. Abercrombie, in his work on "Practical Researches on Diseases of the Stomach," published two years later.

After the subsidence of the notoriety Bretonneau gave diphtheria, it attracted but little attention for several years, till in 1841 an epidemic in the Children's Hospital in Paris brought it again before the profession. This epidemic was described by M. Becquerel. The children of the institution were attacked with sore throat, often attended with membranous exudation, sloughing, and gangrene. The disease was not limited to the faucial and laryngeal surfaces, but appeared also upon abraded and blistered cutaneous surfaces. He noted also a remarkable state of the blood in its want of coagulability.

During the following fifteen years diphtheritic epidemics prevailed from time to time in various parts of Europe, especially in France, and were described by Empis, Lemoine, Jobert and Lespiaen. Dr. Ernest Hart, of London, ably described the great English epidemic of 1858–1859. The first case was supposed to have been imported from Bolougne (probably a relic of the fatal epidemic there in 1855) to Folkstone in 1856. Assuming alarming malignancy in 1858, it spread widely; was very fatal during the following year, and for three years more continued prevalent. The local name was "Throat fever."

In 1856 an epidemic of this disease prevailed in San Francisco and other California towns, and was described by V. Fogeaud in an essay on diphtheria and by Dr. Jas. Blake, of Sacramento. The mortality was very great.

About the same date, Dr. Beardsly of Milford, Conn., described a fatal epidemic of diphtheria in that and adjoining towns, in which the first symptom almost uniformly was pain in the ear a day or two in advance of any other manifestation of the disease.

In 1858 diptheria prevailed in Albany, N. Y., and in many other towns, and may be said to have been constantly prevalent from that period to the present time, not only in this country, but also in England, France, Germany, and most other countries of the globe; and is amply discussed in the books on general practice, and in monographs, of recent date, to be found in the library of every physician.

A complete history of the medical treatment of diphtheria would constitute one of the curiosities of medical literature —more curious than instructive. The terrible fatality which has attended the disease, seemingly little abated by any treatment hitherto practiced, has led to the exhibition of almost every known remedy; but failure still incites to laudable research and trial of new remedies.

Such conditions have caused discrepancy and distrust, and have led many practitioners of eminence to ignore authorities, to discard precedents, to repudiate so-called specifics, and to treat the disease on general principles, or as the symptoms occurring in any case might seem to demand. Confusion and doubt here, as generally, precede order and confidence.

The therapeutical history of the disease, although not intended to constitute an integral part of this treatise, will of necessity, be somewhat developed when we come to speak of treatment in chapters 16 and 17.

CHAPTER IV.

CAUSE.

It is found exceedingly difficult to define *disease* itself, and is much more difficult to discover or define its cause or causes. The cause of certain fevers is said to be malaria, but what is malaria? Malaria is a subtile miasm, or microscopic entity or vapor, exhaled under certain imperfectly understood conditions. Its properties, its constituents, and its sources, are not perfectly known. If fevers prevail alike on either side of a river or morass, who can tell whether the miasm is exhaled or attracted? Neither can we tell certainly, with any or all the chemical and optical appliances known, whether it is animal or vegetable, solid, fluid or gaseous. Then, as we have learned but very little of the laws that govern it, doubtless the part of wisdom is to call it a "subtile entity," beyond the borders of the visible, and beyond the range of inductive philosophy. We have defined diphtheria as a *contagious* disease, and scientists have, for these many years, been searching for the entity which we denominate the contagium, in hopes that its discovery might guide in the discovery of a logical specific remedy. As Salisbury believed that he had discovered the true cause of malarial disease to be a minute vegetable organism, so also Oertel, Heuter, Nasseloff, Eberth, and other German investigators claim to have discovered and demonstrated the cause of diphtheria to be also minute vegetable growths which are denominated Bacteria, and divided into several genera and species.

Any overestimate of the importance of such a discovery, as tending to throw light upon the nature and treatment of the malady is nearly impossible. If, on the other hand, the supposed discovery is not sustained by observation and scientific research, it may equally tend to obscurity and wrong theory, and pernicious treatment. It seems, therefore necessary in any treatise upon diphtheria, in view of the powerful advocacy of the bacterian theory by eminent scientific writers as the above, and the great influence given to the theory by the recent publication of Prof. Ziemssen's Cyclopedia, to somewhat carefully examine its claims, that we may award it all, and only the merit and influence to which it is justly entitled. The following summary, it is believed, gives as correct and authentic a view of this German theory as can be presented in the space allotted.

Two of the numerous species of bacteria, called micrococci, or spherical bacteria, and micro-bacteria, or rod-like bacteria, are supposed either to constitute the disease germs of diphtheria or to be its carriers from one person or locality to others — to constitute the real contagium. By means of the most powerful microscopes most skillfully manipulated, these minute bodies "just on the borders of the visible" are seen only as minute specks, or as oscillating points.

"In every tissue affected with diphtheritic inflammation, in every diphtheritic false membrane, and, in severe cases, in the blood, the tissues, and excreta, are found large numbers of micrococci, associated with a smaller number of micro-bacteria, which increase or diminish in the ratio of the violence of the disease. They accumulate vastly just before the formation of the exudation upon any abraded or wounded surfaces of patients; especially on the edges of the wound produced by tracheotomy.

If any mucous surface exposed to the air, or any abraded cutaneous surface, being the seat of inflammation and occupied by other forms of bacteria, as the leptothrix buccalis, or oidium albicans, is attacked by the diphtheritic form of inflammation, these bacteria at once disappear, and are succeeded by the sphero and micro-bacteria. Again, when the diphtheritic disease abates, these latter disappear and are succeeded by the former.

In the early stages of the disease the grayish spots upon the pharyngeal surfaces are found to consist entirely of these bacteria, epithelial cells, and mucus, and in the later stages only are associated with pus and fibrin, as resultants of inflammatory reaction.

In order more clearly to ascertain the relations of these bacteria to diphtheria, recourse was had to various carefully conducted experiments. Croupous inflammation of the mucous membrane of the larynx was induced by the application of a powerful irritant (ammonia) producing a croup-like membrane. Although the fibrous exudation afforded a soil which varied little, or not at all, in its histological composition from that induced by diphtheria, none of these organisms were found upon nor beneath the inflamed surfaces.

In further experiments upon animals, inoculations with diphtheritic matter were practiced upon the mucous membrane of the air passages, the cornea, and muscles, with the result of inducing a rapid increase of these diphtheritic bacteria (the micrococcus and micro-bacterium) which rapidly penetrated the tissues and induced systemic infection.

Oertel says, "I have noticed in numerous inoculations, that if various bacteria besides the micrococcus, as for instance, bacillus, spirillum, and bacteria lineolum, were present in the matter to be inoculated, only micrococci (sphero-bacteria) and the bacterium termo (in its most minute forms accompanying them) showed evidence of prolific growth, while all the other forms disappeared altogether."

Upon the cornea these inoculations produced a vast multiplication of these bacteria, violent local disease, systemic infection, and death.

Oertel says, "according to my experiments, the bacteria spread over the mucous membrane of the trachea, beset the cellular elements, crowd especially into the young exudation cells, or are taken up by them, and gradually cause their dissolution; they fill the blood and lymph-vessels, and bring about in a mechanical way, a damming up of the fluids, and, as a consequence, serous exudation. As they close up the capillary vessels, they occasion stagnation in the blood circulation, which induces disturbance of nutrition in the walls of the capillaries, and even rupture of the same. Muscular fibres, also, which are covered and filled with colonies of micrococci, degenerate and slough; in like manner, in severe cases, immense numbers of bacteria appear heaped up in the uriniferous tubules and Malpighian corpuscles of the kidneys, and occasion there parenchymatous inflammation, capillary embolism of the glomeruli of the kidney, with ruptured vessels and formation of epithelial casts of the tubes. In the lymph and blood streams (compare also Hueter), in long continued sickness of the animal experimented on, these bacteria also accumulate in masses. They induce, as excitors of decomposition and disorganization of organic nitrogenized bodies, septicaemia, through the vegetative process they undergo, and through their relation to oxygen."

From the foregoing it would be a necessary induction that these organisms, wherever they exist in any considerable numbers in proximity to human beings or other animals, must cause diphtheria, and that the disease could not prevail without their agency. Indeed Eberth, one of the leading advocates of this theory, declares that "without micrococci there can be no diphtheria."

Diphtheria, then, and micrococci, according to this theory, must, or should be, coexistent and coextensive. A trial of the theory by this rule certainly is not open to the charge of unfairness. Eberth's assertion, "without micrococci there can be no diphtheria," is only the logical sequence of the bacterian theory ; and, from the same stand-point it is equally logical, and, indeed, fundamentally necessary to the support thereof, to reason that wherever and whenever this bacterian cause exists, its effect, diphtheria, should occur in the case of nearly every exposed person, as cause and effect are inseparable ; and yet it is true that not even a majority of those most exposed contract the disease.

During epidemics of the disease, according to the views of those holding the theory of Eberth, the superabundance of these entities, especially in the presence of the sick, where they must be continually inhaled by the attendants, should make infection the rule : the actual general exemption from infection, shows, not only the general innocuousness of bacteria, but may be regarded as an intimation of their utter harmlessness to persons in health, a doctrine held by many critical observers. Such comparative exemption, regardless of exposure, is not true of the other contagious diseases of childhood, as scarlatina, rubeola, pertussis, etc. ; and even if it were, would avail nothing in support of the theory unless it could be shown that they, too, were the effect of bacterian or similar infection.

If upon a congenial soil we sow seed in proper season, it straightway germinates and grows through its several stages to maturity; and like results are almost certain to follow if the seed be sown upon any number of fields. Now suppose the field to be the pharynx, and the seed, living bacteria germs; can any reason be given why the crop should fail in a majority of cases even during the epidemic prevalence of diphtheria? This point may be still further exemplified by reference to the habits of another of the microscopic fungi, the torulæ cerevisiæ, or yeast plant. Its soil is chiefly the mash or malt of the distiller and brewer, which, by its instrumentality, is converted largely into alcohol. Wherever this soil with the proper conditions of warmth and moisture exist, thither almost invariably the germinal matter or seeds of this fungus are attracted, and the whole mass speedily is pervaded by its developing and developed progeny. Here failures rarely occur. It is, at least, presumable that the pharyngeal mucous membrane, in a condition of health is a soil nearly always, if ever, in a condition to favor the development of these microzymes, or bacteria germs, and their rapid multiplication; therefore, as in the mash, the results should be very nearly uniform, and infection be the rule instead of the exception. It is certain that no peculiar state of the mucous membrane has been, or is likely to be discovered, which insures exemption from, or specially predisposes to the disease. If the bacterian theory is at all tenable, all persons of the same age, with like sanitary surroundings, by exposure must be equally liable to contract the disease, and should uniformly become infected, were the cause the lodgment of these germs upon the pharyngeal mucous surfaces. As this is not the case, from reasons before indicated, we judge that the theory lacks in essentials, and is not worthy to influence our pathological views or therapeutical measures.

That the contagium or disease germs of the contagious diseases is living matter is neither contested nor conceded, but it is not probably a consequence of the development upon any part or within the system, of microscopic fungi, or packs of micrococci.

On this point Dr. Lionel Beale further remarks, "We must not, however, conclude that if disease germs really do consist of living bioplasm or germinal matter, they must necessarily be of a *vegetable* nature, and have sprung from vegetable organisms, or have originated spontaneously, for it is obviously possible, that, though *living*, their nature may be very different, and they may have been derived from a different source. While I freely admit that the facts of the case are conclusive as regards the living state of the active matter of contagious diseases, I am quite unable to subscribe to the arguments advanced in favor of the *vegetable germ theory of disease*." For a full discussion of these theories, the reader is referred to Beale on Disease Germs.

Bacteria, whose forms cannot be distinguished from the micrococci, are to be found in abundance wherever and whenever animal decomposition is in progress, and yet often for long periods no cases of diphtheria are developed. Bacteria germs grow and multiply whenever a change takes place in the solids and fluids of the organism, which develops compounds suitable for the pabulum of these living bodies. From the fact that bacteria grow and multiply, not only in a few special fields, but in a great variety of different morbid conditions, it is evident they have nothing at all to do with any particular form of disease.

"All attempts to demonstrate various constant species of bacteria, representing different contagious diseases — and many attempts have been made — have completely failed. There is greater difficulty than would appear at first in testing the matter experimentally, for it is probably impossible to introduce bacteria in quantity into the blood of a healthy animal without at the same time introducing putrescent matters which by themselves would occasion the most serious derangement. Active bacteria introduced into a healthy wound or amongst the living matter of healthy tissues, will die, although the most minute germs present, which escape death, may remain embedded in the tissue in a perfectly quiescent state. Before the bacteria can grow and multiply, the death of the higher germinal matter must occur; as long as this lives, it, and the adjacent tissues, are freely permeated by healthy fluids, and will efficiently resist their assaults.

"When pus bioplasts die, and their death occurs when they are placed in any fluid which is not adapted for their nutrition, the vital movements cease, and the corpuscles invariably assume the spherical form. Not unfrequently a change occurs in the outer part, and a sort of membrane, like a cell wall, is produced; the contents become more granular, and they assume the appearance usually given in published drawings. After a short time the matter of which they are composed undergoes change, and is invaded by bacteria germs, which grow and multiply. These bacteria are not formed directly from the matter of the pus which once lived, but it is quite possible that bacteria germs existed in a living but perfectly quiescent state amongst the oldest particles of the living matter on the surface of the pus corpuscle when it was yet alive.

"Bacteria germs less than the 100,000th of an inch in diameter can readily gain access to all parts of the organism, and probably remain alive, though quiescent, for a long while." (Bacteria *germs* are not bacteria, but only the elementary germs from which, as from seed, in favorable conditions they are developed ; denominated also microzymes.) "They may be destroyed in vast numbers in the healthy state of the body, though, under certain local changes, the conditions become favorable to their development and multiplication. It has not been proved that these bacteria or their germs, 'microzymes' have anything to do either with the condition of health or disease, and it has been shown that they do not necessarily give rise to suppuration, inflammation, or other morbid change. Nor has any form of fungus germ whatever been proved to produce any contagious fever. The fungus germ theory of disease, as already shown, cannot be sustained unless many important facts are altogether ignored. Nor is it more probable, that the socalled microzymes, which ultimately become bacteria and vibriones, but never, according to Dr. Sanderson, result in developing fungi, have anything whatever to do with the production or propagation of contagion. It must be clearly understood that the minute particles of bioplasm, described and figured by me in 1863, and in the second part of this work, are certainly not of the nature of microzymes or fungi of any kind whatever; they cannot be called microzymes unless the meaning of the word be completely changed. A microzym becomes a bacterium. A disease germ has no connection with bacteria, microzymes, or fungi, either as regards its nature, properties, or origin." Again, the same author says, "If contagious diseases are due to the entrance into the organism of such minute vegetable germs as those described, is it not wonderful that any one escapes disease? Multitudes of germs of different species, as numerous as are the contagious diseases from which we suffer, must, if this theory be true, surround us. And yet the fungus germs, which are to be detected easily enough, and which indeed do exist in great numbers, are not known to cause any disease. Still, upon this view, these must be the disease producing particles, for they are the only vegetable germs that have been discovered. Passing into our lungs with every inspiration, entering our stomachs with our food and drink, everywhere in contact with our cuticle, in the chinks of which they might grow and multiply, these fungus germs must, one would think, pass, in vast numbers into our blood, and be carried to every part of our bodies.

Contagious diseases ought, therefore, to be more common than they are, and escape from attack should be almost impossible." (Beale, Disease Germs.)

Again, according to these authors, i. e. those holding to the bacterian theory, diphtheria is at first a local disease of the pharynx, air passages, or some denuded surface, and thence is developed into a constitutional one by absorption of the specific principle into the blood, whereas most practitioners and authors reverse the order. Constitutional symptoms are generally *first* to appear, and the local follow just as is the case in variola, scarlatina, measles, etc. It seems quite irrational to ascribe the pyrexial symptoms to a local disease that cannot be said as yet to exist. We might with equal propriety ascribe the rigors, the cephalalgia, the rachialgia, and the fever of the early stages of small pox to a cutaneous eruption which we only *expect*, and which *may* never appear.

J. Lewis Smith, M. D., of Bellevue Hospital Medical College, New York, in his work entitled "Diseases of Infancy and Childhood," in reference to the Bacterian theory of diphtheria, writes as follows. "With an experienced microscopist of New York, I have examined the secretions and exudations upon the fauces in various cases of pharyngitis, both diphtheritic and non-diphtheritic, and we ordinarily found the micrococcus in abundance in the inflammatory product, whether diphtheritic or non-diphtheritic, a secretion or exudation, if it had remained some time upon the surface of the fauces. In one case of simple pharyngitis, no bacteria could be discovered on the first day in the secretion which lay in the depressions over the tonsils, while, on the second day, numerous micrococci had appeared. Micrococci, then, which are not distinguishable with our present means of observation from those in a diphtheritic exudation, may occur in great numbers in the secretion of non-specific imflammations, so that their presence does not afford certain indication of the diphtheritic disease. It is also well known that bacteria, which seem to be identical with those in diphtheria, are frequently found upon the gums, and between the teeth in health. Moreover, in the intervals of epidemics and in localities where diphtheria has not occurred, or has occcurred rarely, the microscope discloses the existence of bacteria, which resemble in form and activity those found in diphtheritic products, and in sufficient numbers to justify the belief that they frequently pass over the fauces with the inspired air. How remarkable, if the bacterian theory is true, that fungi, which, under ordinary circumstances are innocuous should exhibit the fearful energy and destructive power which we observe in diphtheria! It has however been suggested to me, that the diphtheritic bacteria may possess peculiar functions and properties, since it is very difficult to observe differences, which may exist, and classify organisms which are just on the borders of the visible. A fact which, till it is satisfactorily explained, must, I think, throw doubt on the bacterian theory, is that the bacteria do not irritate the lungs. If, during inspiration they are carried along the current of air, and certain of them lodge upon the fauces, where they produce the specific inflammation, a larger number must enter the lungs, where we would suppose, from the delicate structure of these organs, and their proneness to inflammation, they would produce severe results; so far from this occurring, bronchial and pulmonary catarrhs are rare at the commencement of diphtheria, and not common at any stage of the malady."

The foregoing and other considerations, it seems to me, justify, nay, demand, dissent to a theory at once so novel and unsatisfactory.

Facts compel the belief in *primary constitutional infection*, whereas this theory makes diphtheria only a local disease with constitutional expressions or symptoms.

That blood-poisoning, toxæemia, is alone capable of inducing the phenomena of the discease, we may now attempt to elucidate.

The local disease, if it exists at all in the beginning, is quite too trivial to induce the systemic derangements so generally manifested in the early stages of the disease: as

a) The chilliness and pyrexia, with the appearance of general indisposition.

b) The increase of temperature, which is often from two to six degrees, and sometimes even more.

c) The accelerated pulse, often reaching 120 to 140.

d) The prostration, which is often so great in the very beginning as to cause the patient to keep his bed.

e) In malignant cases the great prostration and general lividity of the surface, and occasional sudden death with almost no throat affection.

f) The troublesome vomiting and occasional diarrhœa, which occur sometimes as the initial symptoms.

These are indications pointing only to systemic disease, and as certainly as the magnetic needle points to the pole. They are not all to be expected in any one case, but upon what other theory can we account for any *one* of them? They, as before remarked, constitute the *initial* symptoms, and often precede any considerable local disease, as in the following case.

Oliver Fletcher, of 22 Barber ave., Cleveland, O., a laborer about thirty years of age, suffered severely while at work during the day of Oct. 16th, 1883, with violent headache, frequent paroxysms of chills and fever, together with a feeling of intense fatigue and general indisposition, accompanied by anorexia. Patient was visited by the writer at 7 P. M., after his return from work. He was in bed groaning and exhibiting signs of great distress and alarm. Said he had felt indisposed for several days, in consequence, as he thought, of working with wet feet. He had vomited twice; his countenance was suffused and dark, and the nausea continued. Pulse 110; temp. 104½. He exhibited signs of mild delirium, and had violent pains in region of the kidneys, and occasional rigors occasioned by contact of air in turning over or rising. Tongue lightly coated, fauces moderately injected, not in the least painful; no signs of any exudation, nor complaint of tenderness. Respiration hurried and nervous. Urine scanty, and loaded with urates. (Not tested for albumen.) Diagnosis reserved. Prescribed an alterative cathartic, and three drop doses of tr. veratrum viride. 17th, 11 A. M. Less feverish excitement. Pulse 100; temp. 101°. A little less nervous, but complained of severe pain in the throat. Examination revealed a membranous patch ½ by ¾ in., on posterior faucial surface, tonsils swollen and studded with numerous specks of false membrane, which rapidly increased in size; twelve hours later they had coalesced into large patches. The patient had been delirious during the night, but at time of morning visit was entirely rational. He was put at once upon the chloral treatment, and on the 20th was discharged convalescent.

To the foregoing evidences of primary systemic contamination may be added, others derived from the secretions, as ichorous discharges from the nares, excessive secretion in the mouth and fauces of offensive sticky mucus, suffusion of the eyes, &c. These are so often observed among the earliest symptoms that I will pass by them as too common to require further notice.

The Kidneys. Albuminuria is frequently observed before the blood has had opportunity to become contaminated by absorption of decomposed pharyngeal exudation, and therefore can only be regarded as evidence of the priority of the general disease to the local manifestations. Its occurrence is not to be regarded as evidence of unusual severity of the attack, or of great danger, nor even of disease of the kidneys themselves, but is evidently due to the altered state of the blood and the rapid waste of tissue, which are very early effects of the poison of diphtheria. Urea, normally a principal constituent of the urine, and a product of the decomposition of the tissues of the body, is also found in excess in the very beginning of diphtheria. This is only to be accounted for in the same way as the early occurrence of albuminuria, and affords another incontrovertible evidence that the disease is primarily general, and not local, as claimed by those who uphold the bacterian theory.

The hyaline and granular casts, which subsequently or simultaneously appear in the urine, are to be regarded as the consequence of nephritis occasioned by the overwork of the kidneys in the excretion of the enormous tissue waste, together with the impairment of these organs by the general disease.

In a paper published in the British and Foreign Medico-Chirurgical Review (Jan., 1860), it is affirmed by Mr. Sanderson, "that diphtheria agrees with the other pyrexiæ in being attended with a marked increase in the excretion of urea, and that the existence in the kidney of the condition which is implied by albumen and fibrinous casts in the urine, does not necessarily interfere with that increase in the elimination of nitrogenous material. There is, therefore, no reason to apprehend the occurrence of uræmia as a consequence of the renal complication in diphtheria; this complication not being the cause of the dyscrasia, but merely the index of its existence."

M. M. Bouchut and Empis, as early as 1858 attached great importance and significance to the occurrence of albuminuria as especially indicating primary blood-poisoning, in which its resemblance to purulent infection, which is accompanied by a similar alteration of the urine, is observed. On this point M. Bouchut concludes that "albuminuria, in the absence of scarlatina or asphyxia (dependent upon laryngeal obstruction), is a sign in diphtheritic disease of a commencement of purulent infection, and coincides with a very great gravity of the disease."

Sir Jno. R. Cormack, of Paris, 1876, asserts that albuminuria sometimes occurs on the first day of the disease, and, necessarily, the nephritis upon which it depends.

Smith says (Diseases of Children, page 230), "Important evidence of the constitutional nature of diphtheria is afforded also by the *state of the kidneys.* No internal organs are so often affected in diphtheria as the kidneys, and on account of their location and anatomical relation, it is evident, the poison first passes through the system before reaching them. Any clinical or anatomical fact, therefore, which indicates that the diphtheritic virus has reached and affected the kidneys, affords proof that it has penetrated the system and poisoned the blood. Now the occurrence of albumen, with granular or hyaline casts, in the urine, in cases unattended by dyspnœa, affords proof of nephritis, caused by the action of the poison on the kidneys." He also quotes Sir John R. Cormack of Paris, and gives the two following cases to confirm the statement quoted, that albuminuria and, of course, the nephritis on which it depends, sometimes begins as early as the first day of the disease.

"Case I. L. McD., aged three years, was first visited by me on February 29th, 1876. I learned from the parents that she had been feverish during the previous forty eight hours, and her urine very scanty. A moment's examination was sufficient to show that the case was one of malignant diphtheria, for the fauces were already nearly covered by the diphtheritic pellicle, the temperature was 103¼°, and the pulse 140. The skin was hot and dry, and there was moderate swelling under the ears, and a muco-purulent discharge from the nostrils. On account of the scantiness of the urine, the amount not exceeding four to five ounces daily, it was impossible to obtain sufficient for examination till the next day. It was then found to have a specific gravity of 1032, to contain a deposit of urates and hyaline and granular casts, a diminished amount of urea; and a large quantity of albumen. It can hardly be doubted from the scantines of the urine, and the large amount of albumen found when the urine was first examined, that albuminuria had been present on the first day.

"Case II. The following was a similar case; K., aged four years, living in West thirty-sixth street, was visited by me in consultation on Jan. 29, 1875. Her sickness had also continued forty-eight hours; her fauces were swollen, and covered with the diphtheritic pellicle, which was dark and offensive; respiration guttural; pulse 120; temp. 101°; she had a free discharge from each nostril; urine scanty, its specific gravity 1030; it contained a small amount of albumen, with casts, and a large amount of urates, with no apparent diminution of the urea. Death occurred on the fourth day."

The *false membrane* presents still further evidence of the constitutional cachexia or contamination of the blood. There are but two classes of cases in which it is not present, viz, those in which death from blood poison takes place before the exudation has time to form, and those in which the local disease is not severe enough to cause sufficient exudation to form one.

As before stated, these membranous deposits are often formed upon the surfaces of wounds and sores. In nursing women they sometimes form upon the nipples. They sometimes appear at the orifices of the nares, and may form also in the lachrymal duct and thence extend themselves to the conjunctiva. In a few instances they have been known to invade the æsophagus. The surface of the tongue, the buccal and gingival mucous surfaces, and, in short, any surface of the body open to the air and not covered by a thick epidermis, is liable to be invaded.

It would seem as though in bad cases the virus is so abundant that every available point is sought for its expulsion. It is affirmed that the disease only localizes itself at these several points, and that each is separate from the rest and is only a local malady. What, then, becomes of the other symptoms already alluded to? How are they, or those still more grave that are now so emphatically announced by the rapidly failing powers, to be accounted for? These membranous patches are evidently exudations mainly from beneath, and not merely deposists from above. This is shown by their similarity to the contents of the inflamed structures beneath them. The glands of the throat and neck are stuffed with coagulating fibrin abstracted from the blood; from which, in *health*, it obstinately refuses separation, save for the legitimate purposes of nutrition. A little of this fibrinous material exudes and immediately coagulates to form the basis of the membrane, in the meshes of which, are found entangled lymph and blood corpuscles, epithelial cells, granular matter, micrococci, pus corpuscles, etc. Nearly all of these morbid products are of, or from, the blood and are therefore demonstrative proof of the primary toxæmia.

Glandular swellings in a large majority of cases are observed in the beginning of the attack, before any inflammation of the faucial surfaces or any exudation has occurred, and is another evidence of the primary blood poisoning. "It is not a secondary result of the throat manifestations, but belongs to the general disease itself." (Sir Jno. R. Cormack.)

In those cases which are fatal within the first two or three days, very often no false membrane has formed, and the autopsy reveals only sanguineous congestions of the lymphatics, mucous membranes, and internal organs. In these cases the *violence of the toxæmia* kills, without producing the characteristic pellicle.

Finally, on this point, it may be remarked, that in at least two epidemics reported by competent writers, the initial symptoms did not relate to the throat. In that of 1789 in New York, reported by Dr. Samuel Bard, a slight inflammation of the eyes and a livid countenance were generally the first symptoms. In the epidemic in New England in 1856, reported by Dr. Beardsley of Milford, Conn., pain in the ears preceded by a day or two the other manifestations. In these cases to assign as the cause of the pains the lodgment of bacteria in the eyes, the ears, or upon the fauces, seems puerile.

Having shown, though not exhaustively, that the so-called "bacterian theory" of diphtheria merits little confidence, and that the malady is of a general or constitutional character, which I designate diphtheritic toxæmia, I am ready to confess ignorance of the *real* nature of the virus. That it originates in the living organism is most satisfactorily shown in the elaborate treatise of Dr. Beale, already quoted, and to which the inquirer is confidently referred as the most able, satisfactory, and elaborate work on the mooted subject of "Disease Germs."

CHAPTER V.

CLIMATIC AND ATMOSPHERIC INFLUENCES.

Climate exercises no inconsiderable influence upon the prevalence of diphtheria, although it prevails to some extent in nearly every country.

It has been observed within the tropics, but never, I believe, in the Arctic regions. It is most prevalent in temperate climates, neither extreme favoring its prevalence. It does exceptionally, however, prevail in all seasons of the year. Autumn and Spring seem, in this country, most to favor its prevalence.

I have known the occurrence of extreme heat or cold to greatly mitigate the prevalence of an epidemic.

The germs of diphtheria may remain dormant for a considerable time external to the body, and then be rendered active by favorable climatic or atmospheric states, or when other conditions, favoring such change, occur. Dr. Thursfield found in certain isolated houses and hamlets in England, where, in recent years, he had been called to investigate cases of diphtheria, that, at intervals of five, ten, fifteen, twenty, twenty-five, thirty, and even more years, there had been previous outbreaks of fatal sore throat. In Reynold's System of Medicine is recorded an instance in which the virus remained latent eleven months, and then led to the development of the disease when a person occupied the room, in which a case of diphtheria had previously occurred.

Dr. Mackenzie says, "I have known the poison to remain dormant for four, seven, and eleven months, and in one instance for three years, and then again to become active." Like observations have been made by others, leaving little room to doubt the long continuance of the vitality of the disease germs.

In this country the disease in its prevalence pays little regard to locality, being as frequently met with in high and dry localities as in the valleys or in the vicinity of morasses. It is more prevalent in cities and towns than in the country, although, according to reliable authority, the reverse is true in England, as shown by Dr. Thursfield's observations as sanitary inspector of a district extending over 1200 square miles, "with a population of a little over 200,000, of which rather more than 100,000 are rural; the number of fatal cases of diphtheria in the rural portion is nearly three times that in the urban."

In Germany, and some other European countries, the disease is said to prevail more extensively in winter than at other periods of the year.

Severe epidemics, however, have been known to prevail at all seasons, regardless of weather and temperature. Diphtheria, then, is practically unlimited by latitude or season or altitude.

CHAPTER VI.

MODE OF PROPAGATION.

I have already in chapter I. designated diphtheria as a "contagious disease," hence, in brief, its mode of propagation must be by contact with the "disease germs," be their nature never so obscure or intangible.

Something is generated within the organism of the infected, and disseminated in the air, the water, or the food, which is capable within certain limits of conveying the disease to others who may be susceptible of a like infection. This is what is implied in the phrase "contagious disease."

That this is the mode of propagation observed in this disease, although formerly controverted, is so generally admitted at the present time, that little need be said in its vindication.

Bretonneau maintained that the *exudation* in diphtheria possessed a special virulence, and constituted the real virus of the disease. He says, "Innumerable facts have proved that those who attend patients cannot contract the disease unless the diphtheritic secretion in the liquid or pulverulent form is placed in contact with the mucous membrane, or with the skin on a point denuded of epidermis, and this application must be immediate. The Egyptian disease is not communicable by volatile, invisible emanations, susceptible of being dissolved in the air, and of acting at a great distance from their point of origin. It no more possesses this quality than the syphilitic disease. If the liquid which issues from an Egyptian chancre, as visibly as that which proceeds from a venereal chancre, has seemed under certain circumstances to act like some volatile forms of virus, the mistake has arisen from its not having been studied with sufficient attention. The appearance has been taken for the reality."

He supports this view by citing the following cases.

M. Herpin was surgeon to the hospital at Tours. One day while visiting a child suffering from diphtheria, during the process of sponging the pharynx, in a paroxysm of coughing a portion of the diphtheritic matter was ejected from its mouth, and lodged in the mostril of M. Herpin. Neglecting the removal of this particle, the consequence was a severe diphtheritic inflammation which spread over the nares and pharynx. The constitutional symptoms were extremely severe, the prostration great, and convalescence occupied more than six months.

Dr. Gendron received a portion of the diphtheritic exudation expelled by a patient during a fit of coughing, upon his lips, in consequence of which he suffered severe laryngeal inflammation, and his life was only saved by prompt and decided measures.

A boy affected with frost bite of his foot used a bath that had been employed for a diphtheritic patient, and became the subject of painful, diphtheritic exudation on the great toe.

Trousseau failed in his attempts to inoculate himself and two of his pupils with diphtheritic matter, as did also Dr. Harley of London in his experiments on animals. Still M. Bretonneau maintained that the virus of diphtheria was only transmissible by inoculation. Isambert controverts the opinions of Bretonneau, and says, "We cannot reject infection at a distance as one of the means of propagation possessed by diphtheria." Carnevall and M. Aurelius Severinus, as well as Franciscus Nola and most other writers of the 17th century, admit the contagious nature of diphtheria.

Dr. Samuel Bard, speaking of suffocative angina, says, "The disease I have described appeared to me to be of an infectious nature, and as all infection must be owing to something received into the body, this, therefore, whatever it is, being drawn in by the breath of a healthy child, irritates the glands of the fauces and trachea as it passes by them, and brings about a change in their secretions. The infection, however, did not seem, in the present case, to depend so much on any generally prevailing disposition of the air, as upon effluvia received from the breath of infected persons. This will account why the disorder should go through a whole family and not affect the next door neighbor."

The views of more recent writers on this question may be gleaned from the following extracts from their writings.

Dr. Rankin says, "My own conviction is that it is infectious to a limited degree, by which I mean that when patients are accumulated in small, ill-ventilated rooms, the disease is likely to be communicated, but I do not fear that, like scarlatina or erysipelas, it may be propagated in spite of sanitary precautions still less that the infection may be conveyed by the clothes of those who visit or superintend the patients."

"Out of forty-seven families infected," says Dr. Ballard, "there were only fifteen in which the other members all remained healthy. — — — As a rule, it spread in the houses it invaded chiefly among those members who were most closely in communication. In no case where separation from the sick person has been effected early in the disease, have I noticed that it has spread to the separated individual. — — Jane J., aged ten years, resided at Islington, with her mother, an aunt, and three sisters. On May 1st and 2d she was on a visit at the house of an uncle, whose daughter, Jane's cousin, was kept at home, because she was believed to have a cold. On the 2d, this child exhibited decided symptoms of diphtheria; the attack was slight, and she recovered. On May 6th, a servant in this house was taken ill with a severe attack of diphtheria and was removed to St. Bartholomew's Hospital, where she died. On the 2d Jane returned home, was taken ill on the 3d with diphtheria in a severe form, and died an May 9th. Her mother and a sister, aged fourteen years, were both taken ill on May 11th. She had not been so much with her daughter as other members of the family up to the 8th, when she sat up with her all night. The tonsil sloughed, and there was a complete cast of the trachea expectorated. She died on the 18th. The sister, who was also attacked on the 11th, slept with her mother, and when not at school, was continually in and out of Jane's room, sitting there sometimes for hours together. She died on May 14th, asphyxiated. Another sister who slept with Jane and the aunt, suffered from nothing but a slight sore throat."

M. Daviot and Dr. Moncton, (London, 1857), regard diphtheria as purely and simply an epidemic disease, and not contagious.

Dr. Jenner comes to the following conclusions :—"First, that the disease is infectious; second, that the infecting element does not require for its development any of the ordinarily considered antihygienic conditions; third, that the family constitution is one of the most important elements favoring the development of the disease and determining its progress; fourth, that it is very doubtful even if any of these hygienic conditions favor its development, or give it a more untoward course when it occurs."

Dr. Mackenzie (1879) gives it as his opinion that "The disease may be imparted to others by a person actually or lately suffering from it, but the extreme difficulty of effecting *artificial* implantation would tend to show that direct contagion is rare. From this fact it would seem probable that the contagium, when set free from the affected individual, undergoes further development, which increases its disease-producing properties."

In proof that the contagion may be conveyed by a person not actually affected by the disease, Dr. Mackenzie quotes the following very remarkable case reported by Dr. Thursfield :

"A woman living in an infected house, but not at any time suffering herself, walked a mile or two and crossed a ferry to visit a friend. She only remained a short time in the house, but sufficiently long to leave the germs of diphtheria, which broke out a day or two afterwards."

Again he says, "I have known the disease caught from a patient, who had entirely recovered from it four months previously; but whether it was conveyed by the person or clothes of the individual, it was impossible to determine."

The distance at which the contagion can act through the medium of the atmosphere appears more limited than is the case in typhus or small pox. Thus in my own practice, two families resided in the same house, in one of which were three, and in the other four children. In the former all the children were affected with the disease, and one died; in the latter, although the children were continually about the yard and house, though not admitted to the apartments of the sick, all escaped infection.

Mackenzie says, "I have known an instance in which seven children were affected in a house, which had a residence on each side of it, and a third opposite, at a distance only twenty-five feet. Although in all of these buildings were young children, no other case of diphtheria occurred." Many similar illustrations might be given. It would seem, however, that in certain conditions the diffusive powers are increased, and the poison wafted over extensive tracts of country.

It is seen by the foregoing that the poison may enter the system, *a.* Possibly by direct contact.

b. Through the circumambient air; (see remark 2.)

c. With the water that is drunk, or the food that is eaten.

This last proposition, though apparently self-evident, I regard as most difficult of satisfactory proof. During the prevalence of epidemic disease people are more guarded in this than most other respects. The following cases, somewhat to the point, are taken from Prof. M. Mackenzie's late work. A greyhound was seized with symptoms akin to diphtheria four days after swallowing the excrements of a child, who died of that disease; after death, a membraneous exudation was found upon the animal's fauces.

Three sows which had access to a piece of waste ground, on which the discharges or excretions of some patients suffering with diphtheria, were thrown, quickly died with symptoms of suffocation, enlarged sub-maxillary glands, and, in one case, with diphtheritic membrane in the fauces.

These instances go to prove the possibility of systemic infection by means of the ingestion of morbific matter.

REMARKS.

1. The infectious matter contained in the secretions may not only be exhaled into the air, and thus by inhalation, or absorption through the cutaneous surfaces, be the means of infection; it may likewise find its way into privy vaults and thence to neighboring wells, contaminating the water, making it infectious; or into sewers from which through defective traps it may be exhaled into dwellings at even remote distances: or through catch-basins it may infect children playing in the immediate vicinity.

2. Inoculation with diphtheritic false membrane,by Trousseau, Peter, and Duchamp, upon themselves, and by Harley upon animals produced either no effects or only such as relate to common purulent infection. As practiced upon rabbits by Trendelenburg and Oertel, it produced diphtheritic membrane in the trachea, general infection, and death the third day.

Nassiloff and Eberth, Heuter and Oertel, succeeded in inducing membranous exudations upon the cornea, upon the edges of wounds, and death of the animals on the second day from septicæmia, which may have resulted from the inoculation with decomposing animal matter. It is not, therefore, rendered *certain* by these or any other experiments with which the author is acquainted, that true diphtheria has yet been induced by the process of inoculation.

Further critical observations seem necessary to settle this point.

CHAPTER VII.

PREDISPOSING CAUSES.

Age. In Great Britain the Registrar General's returns give an analysis of about 70,000 fatal cases. In each thousand the age at death is shown in the table below:

Age.	No.
Under 1 year	90
From 1 to 5 years	450
" 5 " 10 "	260
" 10 " 15 "	90
" 15 " 25 "	50
" 25 " 45 "	35
45 and upwards	25
	1,000

In the epidemic of Florence, in the years 1871 and 1872, out of a total number of cases of 1546, only fifteen were over thirty years of age.

It will thus be seen that diphtheria is peculiarly a disease of childhood, the vast majority of cases occurring between the ages of one and ten years. Infants at the breast generally escape, and the younger the child the less liable it is to contract the disease.

In the table above given, we notice that the liability during the first year is (judging from the fatality) just equal to that of the aggregate of the five years between ten and fifteen. If then it be proper to say, as above, that "infants at the breast generally escape," so it may be said that those above ten years of age generally escape, and the greater the age past fifteen the greater the exemption.

Sex seems to exercise no appreciable influence upon the susceptibility to diphtheria.

Constitutional predisposition varies greatly in different families, and is no doubt greatly influenced by modes of living and sanitary surroundings. The author is able to recall a number of instances illustrating this statement. The family of H., residing at No. — Columbus St., Cleveland, Ohio, with no particular constitutional taint except that induced by the intemperance of the father, gross and unhealthy food, and filthy habits, were attacked in the Summer of 1874, and two of three cases were quickly fatal, while all the other families in the same neighborhood, of better habits and consequently better constitutional health, and with an equal or grearter number of cases, at first, at least, of apparently equal malignity, and having the same medical care, recovered without loss, except in a single instance with similar surroundings to the first.

Sir Wm. Jenner lays great stress upon "family constitution" as being "one of the most important elements favoring the development of the disease and determining its progress."

In one of his families five members took the disease, in two others, four each, and in eight, two each. In the Lancet, vol. I., p. 919, are reported two examples; in one family eight, and in the other six cases were fatal within a few days. Few active practitioners of the present day in our cities but have noticed similar cases. I have known several such in our own city,— cases in which every child in families numbering from one to five, have been suddenly removed.

I have been wont to attribute these results to constitutional predisposition; meaning dyscrasia and the result of evil habits, which I think more expressive of the facts than "family susceptibility" employed by Jenner and others.

Mackenzie gives the following. A poor woman had three children of her own, and took care of two others in no way related to herself; her own children were attacked by the disease and one of them died. The two other children not her own, who were constantly in the same rooms with the patients, never suffered from the disease.

Four families occupied the same house, and each had several children. In two the mothers were sisters, but not related to the others. All the children related to each other had diphtheria severely whilst the children of the other two families escaped entirely, although no attempts at isolation were made, the healthy children often entering the rooms of the patients.

Neither *rank, station* nor *occupation* seem materially to influence the liability to the disease. Its visitations are regardless of modern improvements in human habitations, of the ease and luxury of the rich, the exaltation of rank, as in the family of the first Napoleon, the present royal house of England, and as some claim, the revered Washington. Dr. Greenhow remarks, "Station of life and the enjoyment of affluence, or exposure to the privations of poverty, seem to have but small influence either in predisposing persons to take or to suffer severely from the disease."

Prof. M. Mackenzie says, "It must not be forgotten, moreover, that when diphtheria becomes epidemic in a town, an elaborate system of drainage is calculated to convey the poison by means of the sewers, and that water closets afford a ready means of contaminating cisterns and introducing sewer gas into residences. Hence the wealthy are sometimes subjected to the causes of infection, which the poorest may escape."

Although the *prevalence* of diphtheria may not be materially affected by sanitary conditions, no medical man will doubt that its *fatality is.* Every one knows that good medical care, good nursing, and good sanitary surroundings, are prime factors each in the restoration of the sick, and not less so in diphtheria than in typhoid or scarlatina.

Among the affections predisposing to the disease we must not omit *catarrh of the air passages.* We have before shown the increased liability to diphtheria in inflamed and irritated states of the mucous and cutaneous surfaces; hence also scrofulous inflammation and other glandular enlargements and diseases of the skin may properly be ranked with the predisponents.

Measles and *scarlatina* stand prominent among the predisposing causes, and when they are succeeded by the disease it is commonly denominated "Secondary Diphtheria."

It is the opinion of writers that the predisposition to diphtheria is lessened by *previous attacks of the disease.* The immunity thus conferred must be very trifling, as it is no uncommon occurrence for persons to have the disease a second and a third time. I have seen in my own practice several such cases, well characterized, and one in my own family of great severity and danger with large membranous patches in the fourth attack. Dr. Mackenzie says, "I have myself known three instances in which children have died from the second attack." In another case a patient had diphtheria in May, and again in a fatal form in the July following. Still, it is not necessary to dissent *entirely* from the idea of partial immunity resulting from antecedent attacks.

CHAPTER VIII.

PERIOD OF INCUBATION.

This may and probably does vary according to different degrees of susceptibility, and the greater or less dilution of the contagium. According to my observation of cases, I should say it ranged from a single day or less (rarely), to fourteen or fifteen days.

Prof. J. Lewis Smith, of New York, reports the following on this point: "A boy of nine years was in the same room about one hour on Saturday with a child who had fatal diphtheria. On the following Tuesday, without any other exposure, he sickened with a malignant form of the same disease. Mrs. E. assisted in nursing a fatal case of diphtheria from Nov. 11th to 13th, 1874, after which she returned home, several blocks away. On the evening of the 15th she complained of sore throat, and on the following day the diphtheritic pseudo-membrane was observed over her tonsils. On the 19th the exudation had disappeared, and she was convalescent. On the 20th her sister residing with her, and who had not been elsewhere exposed, was similarly affected, and after three or four days also convalesced. The only other case in the family, a boy, sickened with diphtheria on Dec. 2nd." He pronounces the period of incubation to be from two to eight days, with perhaps an occasional case outside of these limits.

Prof. Mackenzie writes, "A girl, aged six, who had been absent from home five weeks, returned one afternoon at four o'clock. Her young brother, aged four, had shown symptoms of sore-throat the same morning, but no suspicion was entertained that the disease was diphtheritic. These two children remained together till bedtime, but did not sleep in the same room. The next morning both of them had marked diphtheria, with an abundance of false membrane. The little girl had not been subjected to any infection before reaching her home." The extremes seem to be a few hours and fifteen days. These deductions are in accord with most other authorities, and are entitled to great confidence.

CHAPTER IX.

PROPHYLAXIS.

"Patients affected with the disease should be isolated as far as practicable. Vessels receiving the excretions should be disinfected. Everything coming in contact with the patients should be disinfected or destroyed, and disinfection should be added to thorough cleaning of the rooms and furniture after cases have terminated." (Flint.)

The foregoing is an epitome of the teachings of the best authorities both in America and Europe. Isolation may be effected by the removal of the patient or the other members of the household to separate apartments as far apart as practicable, and prohibiting all intercourse. Disinfection of the vessels receiving the excrements may be effected by keeping in them a small quantity of dry calc. chlor., a ten percent solution of acid. carbol., or an eight percent solution of choral. hyd., &c., with frequent scalding with hot water after use. These measures are also useful for disinfecting the atmosphere of the apartments, which may also be promoted by hanging sheets or blankets, wet with similar solutions in the windows or doorways of the sick room. The clothing of patients and cloths used around them are disinfected by immersing them in hot solutions of calc. chlor., of about the strength of ℥ i to cong. i.

All carpets and unnecessary furniture and hangings as well as needless clothing should at once be removed from the apartments of the sick. After recovery the room, tightly closed and containing all its furniture of every kind not otherwise purified, should be disinfected by the fumes of burning sulphur, in the following manner: Dip cotton or linen cloths of considerable size in melted sulphur, and put one or more of these in an open iron vessel so placed in the apartment, as not to endanger it by too great heat, and ignite. Having thus filled the room with a dense volume of the smoke, leave it closed two or three hours, when, after thorough ventilation, disinfection may be considered perfected, and the apartment fit for occupation.

The author's views on *medical* prophylaxis are given incidentally in the subsequent parts of this work, and at the close of chapter XXI, and they are regarded as of prime importance on account of the efficiency of the measures recommended.

CHAPTER X.

SYMPTOMS.

We will next describe a *typical case* of diphtheria as it is generally seen in this country, with the most common complications, in the order of their occurrence. In order to facilitate the description and aid in the investigation, I have divided the disease into three periods or stages, all necessarily varying in degree and duration. The *first* or *initial* stage extends only to the formation of a distinct false membrane, the only real diagnostic of true diphtheria. The *second* period or stage begins with the close of the first, and extends to the disappearance of the false membrane. The *third* period embraces the entire period from the close of the second to complete recovery.

First stage. This stage is characterized by languor, the patient evincing little relish for amusements; the appetite is impaired, there being sometimes complete anorexia with vomiting, which in this early stage is indicative of considerable severity as the disease shall develop. Diarrhœa at this period is occasional but not common, and if slight, may be regarded as salutary; but if severe and accompanied by other violent symptoms, indicates a grave form of the disease.

"The symptoms of invasion have less prognostic value in diphtheria than in most other infectious maladies. We meet cases with a severe beginning, attended by delirium, which terminate in apparently complete restoration to health in less than a week, the presence of the characteristic pellicle on the fauces, and the occurrence of diphtheria in other members of the family rendering diagnosis certain. On the other hand, a mild commencement sometimes ushers in a fatal form of the disease. This is notably true of these cases in which laryngitis supervenes, as it not infrequently does in cases which begin very mildly." (Smith.)

If inquired of, the patient will probably complain of headache, and a sense of fullness or slight soreness of the throat. The neck feels stiff, swollen, and tender, and deglutition is slightly painful. Examination will be likely to reveal redness and congestion of the faucial surfaces. The tonsils will appear somewhat swollen, and coated with tenacious mucus. Occasionally specks of yellowish or whitish exudation scarcely distinguishable from thickened mucus, translucent, and appearing slightly elevated, will be observed upon the tonsils, uvula, or other parts of the faucial surfaces. These are to be regarded as the elementary exudation, or false membrane, characteristic of diphtheria.

Severe chills are rare; the patients, however, generally complain of chilly sensations, and instinctively avoid exposure to cold. This state is quickly followed, or it may even be accompanied by increase of temperature, proximately 100° to 105°. If the patient is an adult, he often complains of giddiness, and pain in the loins.

The tongue is moist and clean, or slightly coated. The pulse will generally be found soft, and only slightly if at all accelerated. The patient may still continue to walk about and regard his ailment very trifling, notwithstanding the physician may regard it with considerable anxiety.

In *malignant* cases the attack often begins with severe rigors, and in addition to headache and vomiting there may be hæmorrhage from the nose, and the patient is greatly prostrated by the virulence of the attack. The throat symptoms may not be more severe, but the secretions undergo rapid decomposition and impart to the breath an intolerable fetor. The pulse is small, rapid, and irregular; the temperature is not high and may even be less than normal. The patient, restless at first, soon becomes apathetic and drowsy; face pale; skin cold and clammy, and of an ashy color; the tongue dry, tremulous, and of a brown or blackish color, and sordes already begin to accumulate on the teeth. Hæmorrhages sometimes occur from the throat or nasal passages or other mucus surfaces, and petechiæ often appear beneath the skin. In such cases the patient loses consciousness or becomes delirious, and may die even in this early stage in a state of coma, or from an attack of syncope.

This period, sometimes inappreciably brief, may continue one or two days, and is terminated by the appearance of the distinct false membrane which characterizes the beginning of the second stage.

It must not, however, be inferred that cases, stages, or symptoms, are so uniform that all the conditions of any two cases will be found identical. They vary widely, but are recognizable by the experienced physician by common characteristics which cannot be fully defined.

Second stage. The patient has generally by the beginning of this period taken to bed, and appears really sick. The eyes seem a little suffused, the cheeks red or dusky. The voice sounds thick although respiration is unimpeded. Pyrexial indications are more pronounced. Complaint is made of painful deglutition; the parotid and submaxillary glands and the lymphatics of the front and sides of the neck are some or all of them swollen and tender. When this swelling is limited to the parotids, the appearances are often suggestive of mumps, for which the disease has been mistaken. The neck often appears large and brawny, there being superadded to the glandular infiltration no inconsiderable degree of cellulitis. The cells are filled to a greater or less degree with solid material, in its composition doubtless analagous to the exudation that occurs where the epidermis is removed.

This state of the structures of the neck may continue or even increase during this entire period. Occasionally suppuration occurs, especially in cases following scarlatina. In cases of unusual debility, this condition must be considered critical. Preventive means should be employed.

The skin in most cases feels hot and dry, in others it is moist. The pulse is generally accelerated and may number 90, 100, or even 120 or more, and is soft. In those cases tending to malignity, as before stated, it is greatly accelerated, small, and irregular. Exceptionally, too, at this period, the pulse rate is found extremely low, counting only from 30 to 60. This is to be accounted for by the effects of excessive toxæmia upon the brain and nervous system. During the early part of this stage the temperature in most cases is high, often reaching from 104° to 105° or even higher, but during the first few days, in most instances, gradually subsides as the exudation extends. In a few cases it remains high, and may even increase during the period of exudation. M. Farralli, of Florence, states that it usually falls to the normal by the fourth or fifth day, though in moderately severe cases it shows a tendency to rise after that date.

"The fever which ushers in diphtheria, abates after the second or third day, and subsequently, in grave as well as in benign cases, there may be little or even no elevation of temperature. The diphtheritic poison does not, therefore, like that of scarlet fever, exhibit any marked tendency to increase the animal heat. Even in profound and fatal blood poisoning in this disease, the thermometer shows the normal, or scarcely more than normal, temperature, so that the inexperienced practitioner is apt to be deceived in his prognosis. On the other hand, a continued elevation of temperature with only moderate angina should lead the physician to examine for some complication, perhaps a nephritis." (Smith.)

The asthenic character of the disease as well as the primary blood poisoning is not only exhibited by the temperature and character of the pulse, but by the appearances of debility, which the patient exhibits, and by the albuminuria, which is at this stage a common symptom. The urine is high colored and scanty, and, as in other febrile diseases, is found to contain an excess of urea as well as albumen, with hyaline, granular, and epithelial casts. As might be expected, the patient is thirsty, though often refraining from drinking on account of pain in swallowing. The appetite is variable, generally poor, and vomiting not rare, which, with the painful deglutition, often renders nutrition difficult. Vomiting is, in my opinion, generally to be attributed to the influence of the primary morbid poison on the nervous system, being in some sense a measure of the toxæmia. Smith regards it as frequently the result of uræmia. The strong analogy of this effect of diphtheritic poison to other well known systemic poisons, for which antidotes have been discovered, is a suggestion of some weight in favor of the antidotal treatment of this malady, which will be brought forward in a subsequent part of this treatise.

The bowels may be constipated, relaxed, or normal.

The mind, except in malignant cases, generally remains clear throughout the disease. More or less delirium, however, is often met with, and is to be interpreted in connection with the other symptoms.

The tongue in the early part of this stage is generally moist and slightly coated. The coating is generally yellowish or grayish; if dark colored and dry generally indicates a typhoid state, and is one of the indications for stimulating treatment.

The tonsils are more swollen than in the first stage, and the secretion covering them more dense, yellow, and viscid. This condition occasions often repeated efforts by hawking and spitting to clear away the annoying secretion. Even the hawking may indicate varied degrees of violence. Upon the surface of the tonsil or in other parts of the pharynx will now be observed the characteristic patches of exudation, of a yellowish or whitish color, elevated above the surrounding mucous surface, and, in proportion to their development, presenting a more dense and leathery or felted appearance. These render the diagnosis positive. If they be forcibly detached, their intimate connection with the submucous tissue will be rendered apparent. More or less hæmorrhage follows their separation, which with the fibrils projecting from their under surface shows their connection with the capillaries beneath, and evinces the derivation of the membrane from the blood by exudation. If abundant, therefore, it shows violent toxæmia, and the future developments will probably be proportionate in severity. They further indicate by their fibrinous structure such a condition of blood as leads to coagulation of its fibrin. This state is further evinced by the frequent occurrence of fibrinous clots in the heart, and in the course of the circulation. As the disease progresses, these patches tend to extend their area and coalesce, sometimes forming a continuous coating over most of the pharyngeal surfaces. Their thickness is at first constantly increased by continued exudation upon their lower surfaces, and hence their elevated appearance. If, however, the contiguous mucous surfaces be so swollen as to be even with or elevated above the edges of the membrane, it appears depressed.

By extension and coalescence these membranes sometimes reach the epiglottis and ary-epiglottic folds, or the larynx, and even the lower air-passages, constituting diphtheritic croup. This form of disease is characterized by most of the symptoms of pseudo-membraneous laryngitis, or true croup, with which it was considered identical by Brettonneau, and since his time by many French and English authors. The most recent and able advocate of their identity is Prof. Morell Mackenzie, M. D., of London. We are obliged, however, after a careful consideration of facts, to dissent from this view, which will receive further consideration hereafter.

The voice in this condition at first becomes husky, high-pitched, and is at length extinguished. The cough becomes hoarse, shrill, barking, stridulous, and finally entirely aspirate or voiceless. This is often called the croupy cough, and never fails of recognition after being once heard. The breathing becomes labored, stridulous, and insufficient for the regeneration of the blood, hence the countenance becomes suffused, swollen, purple, and the eyes seem to protrude from their sockets.

If the chest be examined, both the inspiratory and expiratory sounds will be found prolonged, and the bronchial and vesicular murmurs obscured or rendered inaudible by the laryngeal stridor. The intercostal and supraclavicular spaces are more depressed during inspiration than during healthy breathing, and more prominent during expiration. The dyspnœa continues to increase and the patient suffers from repeated attacks of suffocation. When these attacks occur, the little sufferer springs up in bed, the face is gorged, and livid, the expression terrified and indescribably anxious. The nostrils are rapidly expanded and contracted, breathing is nearly impossible by even the greatest effort, and the hand is often thrust into the mouth or clutches the throat in a vain effort to remove the obstruction. After a few minutes the paroxysm subsides, and a period of comparative repose, sometimes of several hours' duration, ensues. The continuous cough and sense of a foreign body in the throat leads to paroxysms of vomiting, during which patches of false membrane, varying in size, are often ejected with considerable relief to the sufferer. Death, however, from closure of the glottis by the exudation or by œdema has been the usual result, which is only occasionally prevented by energetic timely treatment. Such is laryngeal diphtheria or diphtheritic croup.

If, on the other hand, the membranous extension be to the nares, or if they constituted its original seat, the case is denominated *nasal diphtheria.*

"In some epidemics of diphtheria the disease commences with nasal catarrh, and this phenomenon was so common in the epidemics witnessed by Bretonneau that he regarded it as the ordinary course of the disease. Further experience, however, has demonstrated that catarrh of the nose is far less usual than was at one time supposed, and that true nasal diphtheria is generally due to the extension of the plastic inflammation from the pharynx. The disease commonly first shows its appearance by an unhealthy brown ichorous discharge, which causes abrasion, and even ulceration of the skin in the neighborhood of the nostrils. Soon afterward the parts are covered with false membrane, which can be seen extending through the nose. At other times the false membranes do not reach the external orifice, but, on using the speculum, a few scattered deposits of lymph can be discovered on the mucous membrane of the septum or turbinated bones. The false membrane, however, is generally most abundant at the posterior nasal orifices" (Mackenzie.) During the progress of nasal diphtheria epistaxis often occurs.

The lachrymal duct is occasionally the seat of diphtheritic inflammation and exudation, causing by closure of the puncta an overflow of tears. Following this route it occasionally extends to the conjunctiva.

If it follow the tract of the eustachian tube it occasions complaint of noises and darting pains in the ears, and deafness, followed, perhaps, by perforation of the membrana tympani and purulent discharge from the ears.

When the false membranes begin to decay or separate, the breath sometimes becomes fetid and very offensive. The fetor is often erroneously regarded as that of gangrene. The products of the decay of these membranes, if neglected, may lead to true local gangrene of the diseased and debilitated structures of the throat. They may also by absorption into the circulation produce pyæmia with its troublesome or fatal consequences. These may all be prevented by the timely use of appropriate antiseptic medication.

If a patient suffering from diphtheria in this stage has any portion of the body denuded of its covering of cuticle, as from blisters, open sores, or surgical injuries, these parts often become coated with the exudation, sometimes forming troublesome ulcers, occasionally, perhaps, fatal. Two children in the same family living in L. st., Cleveland, were attacked upon the same day with diphtheria. When first seen the boy had large patches in the throat, much glandular enlargement, and upon a sore on his left ankle, a diphtheritic membrane well formed. The foot was hot, swollen, and exquisitely tender. The girl, beside severe diphtheria in its usual locality, had marked manifestation of the disease upon two sores upon the dorsum of the left foot. The limb, as far as the knee, was greatly swollen and of an erysipelatous color. The sores were foul at the edges, with a distinct membrane covering the centre, and depressed below the level of the surrounding swollen integument. The constitutional disturbance was very great. Under appropriate treatment both cases terminated favorably in about ten days.

The other mucous openings, as the rectum, vagina, and urethra, are likewise the occasional seats of violent diphtheritic disease. I have known a female patient, otherwise apparently likely to recover, destroyed by vaginal diphtheria.

Occasionally also quite severe diphtheritic inflammation with patches of exudation may be observed on the buccal and gingival mucous surfaces; upon the lips, and upon or beneath the tongue.

So great, indeed, is the dyscrasia that wherever in the nature of the case it is possible, there occurs this exudation of the fibrinous elements of the blood, depriving the circulating fluid, in a measure, of its nutritive properties. It is during this second stage of diphtheria that gangrenous symptoms occur, constituting *gangrenous diphtheria.* As before remarked, this state may result from the irritating and poisonous effects of the matter of decomposition of the false membrane, upon the inflamed and weakened contiguous structures. It may likewise result from constitutional peculiarity or debility, but most frequently occurs in cases supervening upon scarlatina. "The gangrene frequently supervenes with great rapidity after the formation of the false membrane, so that in two or three days a large portion of the pharyngeal mucous membrane may be sphacelated. In some cases there is considerable swelling of the cervical glands, but this lesion is not invariably present. As the morbid process becomes fully developed, it is, in all instances, accompanied by a remarkable prostration of the vital powers. A state of collapse comparable to that which occurs in cholera, indicates the intensity of the blood-poisoning; there is great loss of body-heat, and the pulse soon becomes slow and infrequent. The extremely feeble condition of the circulation is shown by the pallor, coldness, and bluish discoloration of the skin, especially of the extremities and prolabia. The expression of the face is strikingly altered and pinched. The patient generally dies from syncope, the intelligence often remaining intact to the last. In some cases, however, he becomes comotose, and occasionally symptoms indicative of profound lesions of the thoracic or abdominal viscera are manifested. These cases always terminate fatally." (Mackenzie.) It is by no means rare during the second stage for *hæmorrhages* from the pharyngeal or nasal surfaces to occur, either as a consequence simply of the intense local congestion or the detachment of the false membranes.

This ought, perhaps, to be attributed as much to the disorganized state of the blood as to vascular engorgement, which is not sensibly lessened by the loss. The effects of hæmorrhage, be it never so slight, in a disease so generally characterized by debility, is to be deprecated, as by increasing the debility it decreases the chances of recovery. It should be prevented or arrested when possible.

Skin eruptions occasionally occur during this stage, and in some epidemics are common among children, and generally consist of a rash upon the neck and chest resembling that of scarlatina. It sometimes appears upon the face, abdomen, and thighs. Neither the date of its appearance nor its duration are at all uniform. In a few cases it persists for several days; in others but a few hours; and it is seldom or never followed by desquamation, like that of scarlatina. It usually disappears before the close of this period.

The *catarrhal* state, mentioned among the predisposing causes, may, during this stage, occasion cough from bronchial or pulmonary irritation. Any catarrh, whether recent or otherwise, is mainly pernicious as tending to change the more common forms of the disease to nasal or laryngeal diphtheria, therefore any exposure to its causes should be studiously avoided.

The duration of this stage is exceedingly various. In the mildest forms of the disease it can hardly be said to exist, there being very little exudation, or none at all, and but trifling indisposition. In more violent typical cases it may extend through a period of five to fourteen days.

The *fever* of diphtheria has certain peculiarities entitling it to still further consideration. Like the fever of small pox it is, in typical cases, divided into two periods, which may be denominated primary and secondary, and it follows a tolerably regular course. The primary fever, as before mentioned, comes on rapidly, and even in cases of only moderate severity the temperature frequently rises as high as 103° to 105° F. Within twenty-four hours it begins to decline, and by the end of the third or fourth day the temperature becomes nearly normal. This fever is the result of the diphtheritic blood poisoning.

In cases of only moderate violence the temperature begins again to rise on the fourth or fifth day, and is found to be in proportion to the other symptoms of septicæmia, notably the glandular swelling, which is often attended by renewed exudation. As in small pox, so in all probability this secondary fever results from the absorption of septic matter at the points of local disease. The effects of this secondary infection are more manifest in severe cases which exhibit a typhoid type. In these it rises less regularly, and in degree it is in proportion to the amount of local disease and putrefactive changes. In the more favorable cases the normal temperature is again reached in a few days, whilst in very severe cases it may continue to rise until a fatal termination ensues. Complications may interrupt the natural course of this secondary fever; if of an inflammatory nature they may increase the temperature; if malignant or tending to obstruct respiration, the temperature will be reduced. The course of the fever has been the same where the local manifestation of the disease was limited to a wound, as when upon the pharynx or larynx.

M. Labadie Lagrave gives the following as the results of carefully conducted thermometric observations in fifty-five cases:

"1st. The temperature generally rises to 104° on the first day, and remains at about that point for two or three days, without any marked morning or evening remissions. 2nd. It begins to fall on the third or fourth day of the disease, and then invariably continues to fluctuate between 99.5° and 101.5° unless some complication develops. 3d. Tracheotomy exerts no marked influence on the temperature. 4th. In favorable cases after the initial pyrexia has subsided, the temperature never rises above 102°. A sudden ascent to 103° or 104° on the fifth or sixth day of the disease points to the development of some complication; either acute nephritis, lobular pneumonia, or acute eudocarditis."

Either continued high temperature or a sudden rise after the fourth day should, therefore, lead to careful search for these complications, but may be occasioned by the absorption of morbific matter as before stated.

A few remarks on the manner of the separation of the false membrane will conclude the consideration of the second period. Some forms of treatment cause its apparent disintegration by either local or constitutional effects, or both combined, but reference here is only had to the pathological processes by which separation is effected, independent of the effects of medicinal agents. Prof. Rindfleisch of Bonn says of the false membrane, "It is a whitishgray, compact, felted membrane, which is elevated, perhaps to the height of one-half line above the level of the mucous membrane, and penetrates just as deep into the substance of the mucous membrane, and is most intimately connected with the latter." A sharply defined boundary line separates the living tissue from the dead, as we can convince ourselves with the naked eye, but numerous connective tissue fibres, blood-vessels, nerves, and elastic fibres, pass over from the dead; they must all have separated ere the loosening can proceed. The means which are placed at the command of the organism are inflammation and suppuration. We call this inflammation *reactive*, and unite with it the idea as though this were an answer to the irritation which the diphtheritic scab exerts upon the surrounding mucous membrane; yet a portion of the hyperæmia also may be explained according to static principles, as collateral fluxion. The pus collects between the scab and the healthy parts, and always, accordingly as the fibrous bridges mentioned melt down and tear, the separation begins now at the edges, then at the centre. After it is completed an ulcer remains behind which is disposed to rapid cicatrization; not unfrequently, however, the process repeats itself again at the same place; we have a new scab, and with it anew the necessity of a purulent separation, after whose termination a very considerable loss of substance remains. The cicatrices finally resulting distinguish themselves by their capacity of vigorous retraction, so that the danger of subsequent contraction of mucous membrane canals, especially of the large intestine after dysentery, threatens so much the more, the more diffused the ulceration was."

During this process, there is no doubt, cases are often complicated by blood poisoning from the absorption of the septic matter formed on the under surface of the decomposing membrane, in a manner analagous to that which occurs in surgical cases. Liability to this complication therefore must be somewhat in proportion to the size and thickness of the exudation. It is no doubt difficult to distinguish the effects of this septic material in the blood from the constitutional poisoning by the diphtheritic virus.

Secondary blood poisoning might be suspected from the following symptoms arising during this process. 1. High temperature, preceded or not by chills, followed in a few hours by perspiration and a decline of temperature, succeeded, it may be, by a repetition at irregular intervals of chills, fever, and sweating; feeble frequent pulse, sallowness of the skin, and great prostration. 2. Increased adenitis and cellulitis. 3. Formation of abscesses in the affected glands or in the joints. 4. Evidences of embolism.

Third Period. The pharyngeal, faucial, and nasal or other surfaces are now supposed to be freed from the exudate or false membrane which during the second period demanded such particular attention, and generally the period of convalescence has fairly commenced. There remains little danger of the reformation of the membrane, and should it occur, the patient would still be regarded as in the second stage.

Usually during the process of separation of these membranous patches, in the manner described, the more violent symptoms abate, and in a majority of cases the patients need little subsequent professional care. Convalescence will probably be uninterrupted if the patient have suitable nursing, but all danger is not yet past. On examining the condition of the fauces or other surfaces from which false membranes have been removed, in the lighter cases, and, indeed, most others, no abrasion remains, and little or no loss of substance having occurred, no cicatrix even marks their former location. The swelling and injection of the mucous membrane steadily subside. All local discomfort is gone or rapidly disappears as the general symptoms improve.

The temperature and pulse rate are nearly normal, and remain so.

The appetite is becoming good, and the urine of natural color and quality. The skin has resumed its functions, and the patient is beginning to move about. The muscular weakness is still considerable, and often apparently out of proporation to the preceding illness.

Occasionally, even in cases like the above, the heart's action, still weak, may show signs of failure upon any exertion, and the patient may die suddenly from syncope. Ordinary cases, as well as grave ones, not infrequently are still liable to be affected with diphtheritic paralysis, which will presently be discussed.

A few cases enter this third period with *troublesome ulcers* of the tonsils or fauces which may be slow of healing, as well as occasions of increasing the debility, and consequently augmenting all the dangers incident to this state.

In cases supervening upon scarlet fever, and a few other, *large abscesses* of the glands of the neck are sometimes continued into or are formed during this period, and with every care, occasionally have led to fatal results.

Cases of secondary blood-poisoning extend into this period, the patient suffering from grave typhoid symptoms. These may gradually sink into a profound coma, or suddenly die of cardiac embolism. Convalescence, if it occur, will probably be slow, tedious, and irregular.

Paralysis is the only common, if not the *only*, sequel of diphtheria. The extreme debility which is observed in connection with and following severe forms of diphtheria, sometimes resulting in fatal cardiac syncope, has sometimes been regarded also as a sequel, but should rather be regarded as characteristic of the disease itself.

Paralysis never occurs during the first stage of the disease, and but very rarely during the second. A few cases have, however, been observed during this second or membranous period, of which the following is an example:

E. W., aged thirteen years, attacked with diphtheria Oct. 6th, 1878, was first seen on the 7th. Pulse 108, temperature 102°, respiration accelerated, anorexia, and constipation. The countenance was dull, and deglutition extremely painful. The cervical and submaxillary glands were swollen and tender; the faucial surfaces and tonsils were violently inflamed and were characteristically coated with tenacious mucus. Upon the velum and tonsils in several places were points of exudation, and hoarseness indicated a like condition within the larynx. Within a few hours these points extended rapidly and coalesced, presenting on the 8th an almost continuous surface of dense, yellowish-white, felted, tough, membrane. On the 9th the nostrils were stuffed and patchy, and the voice hoarse. By the evening of the 10th the laryngeal affection became so great that phonation was impossible and the breathing difficult and stridulous. On the 11th the visible mucous surfaces were nearly covered with a continuous dense membrane, and suffocation seemed imminent, and but for the frequent inhalations of a five per cent. solution of chloral hydrate, must, in all probability, have terminated the case fatally. From this time to the 14th the struggle was continuous, and the result doubtful.

Wherever the membrane became detached from the soft palate it seemed relaxed and utterly incapable of retraction. As the surfaces continued to clear up, the voice was nasal, and deglutition and articulation nearly impossible from the muscular paralysis. This palsied state was carried over into and through the third period, and was hardly cured at the end of three months. Restoration was, however, finally complete. Trousseau mentions a case in which paralysis was manifest three days before the disappearance of the false membrane. The occurrence of paralysis is usually, however, during the early part of the third period, and after convalescence has progressed from two or three days to as many weeks, or even after thirty or forty days. The accession is always gradual. It is observed by the attendants at first in defective articulation, nasal voice, or incapacity for suction.

Deglutition is equally difficult. The paralyzed epiglottis allows portions of food to enter the larynx, occasioning spasmodic closure of the glottis and threatened suffocation. An attempt to swallow liquids results in their discharge in part from the nostrils, from paralysis of the muscles of the soft palate ; a small portion enters the air passages causing strangulation, cough, and spasm. In occasional cases the paralysis affects the senses, as the vision, the smell, the taste, the touch, and also different sets of muscles, as those of the eye, the œsophagus, the arms, legs, &c. It very rarely affects the muscles of the bladder and rectum, and still more rarely those of the face. When single muscles only are affected, the abductors usually suffer. McKenzie has seen two cases of *permanent* paralysis of the recurrent laryngeal nerve following diphtheria.

Diphtheritic paralysis affecting the vision is manifested variously. Some have amaurosis in various degrees, others have myopia, or presbyopia, or double vision, or unequal contraction of the pupils, as a result of feeble and unequal sensibility to light. Strabismus has but rarely been observed. Dr. Reynolds has, however, reported a case in the New York Journal of Medicine, May, 1860, in which strabismus coexisted with partial paralysis of the limbs, and the pharyngeal and cervical muscles.

Of the extremities, the lower are generally first affected, the patient experiencing more or less tingling and numbness, followed or attended by trembling, and an uncertain wavering gait, which in severe cases increases to great awkwardness or complete paraplegia. The power of muscular coördination is sometimes so deranged as to resemble chorea. The muscles of the affected part feel soft and flaccid and are in a great measure insensible to electric currents. There is also more or less impairment of cutaneous sensibility. One or both arms may be similarly affected.

Inability to hold the head erect shows the muscles of the neck to be implicated, as in the case of Dr. Reynolds' before alluded to, in which the head fell forward upon the chest.

Paralysis of the trunk muscles has also been observed, deranging and impairing their action and likewise embarassing respiration by the implication of the intercostals and other muscles of respiration. Paralysis of the diaphragm in proportion to its severity occasions dyspnœa, and if complete, which is rare in *all* diphtheritic paralyses, must lead to fatal asphyxia.

The sphincters are also in rare cases involved and occasion incontinence of urine or feces. Should the bladder become affected we might expect retention.

An unlooked for fatal result, occurring suddenly, has sometimes been attributed, with reasonable probability, to paralysis of the heart.

No other contagious disease is so often followed by paralysis as is diphtheria. Its cause has not been revealed by the vast labors bestowed in its investigation, and we are only able to say that it is one of the effects of the diphtheritic toxæmia. Brown Sequard attributed it to reflex irritation. Others attribute it to anæmia, to degenerative changes in the peripheral nerves of the paralyzed parts, evinced by the disorganized state of the nerves seen in post mortem examinations, &c.

The pathological changes observed in the nerves are not probably limited, however, to the affected parts; but being occasioned by the general toxæmia, rather than by any special local cause, are general. What relation these changes bear to local paralysis, often remote from the seat of membranous exudations, is altogether conjectural. Sanne reports a case of paralysis in a child having no false membrane except upon the skin about the navel, and another, in which it was only observed upon one ear.

The proportion of cases of diphtheria followed by paralysis has been estimated by Mansord at about ten per cent. Of the 1117 cases collected, it occurred in 111.

The ratio of cases is probably not uniform and has been rated as high as 15 per-cent.

According to Trousseau the operation of tracheotomy increases the proportion, or predisposes to the affection.

Finally, all that is really *known* of this remarkable sequel of diphtheria may be condensed into a single sentence, thus: Its accession is insidious, generally beginning in the pharynx, is slowly progressive, continues for a variable period, and then still more gradually declines, and is rarely permanent or fatal.

CHAPTER XI.

DIAGNOSIS.

The diagnosis of diphtheria during the first stage is difficult or impossible. There is hardly one of its symptoms or appearances but is common to one or more diverse diseases. We have stated before that the appearance of false membrane alone is diagnostic of diphtheria, hence a diagnosis based upon any other evidence, or all others combined, partakes to some extent of the nature of guess work.

Generally the physician is able at his first visit to recognize the disease by the presence of the pseudo-membrane, as he is not commonly called till patches in the throat have been discovered. When any difficulty arises, therefore, it will probably depend upon some deviation from its ordinary manifestations.

The case may be *diphtheria*, and yet so mild in its type as not to occasion any membranous exudation, and therefore cannot be positively diagnosed. Again, the patient may be stricken down by such violent diphtheritic toxæmia as to die before a membrane forms; diagnosis is here also impossible.

In the first stage the question may arise as to whether the case is ordinary catarrhal sore throat or diphtheria. The known differences are so slight that only a history of epidemic prevalence or individual exposure can throw any light upon the question, and the diagnosis should be simply "doubtful."

In common sore throat in which the tonsils are covered here and there with patches of a grayish pultaceous deposit, easily removed, the *deposit* may safely be pronounced non-membranous, but yet leaves the case in doubt.

Is the case to be differentiated from thrush with patches of muguet on the tonsils? The spots of elementary diphtheritic membrane may sometimes be distinguished by the greater difficulty of detaching the exudation, and the slight hæmorrhage which follows its removal; the product of thrush bring more easily detached and usually without bleeding.

Diphtheria has very often been mistaken for scarlet fever, and vice versa. Although there are here points of resemblance, there are also differences sufficient for a pretty safe diagnosis. There may be fever, sore throat, and possibly a papillary eruption, yet neither, separately, nor all combined, are diagnostic. We perhaps find the papillæ of the tongue elevated and red, and place this appearance on the side of scarlatina.

Fever characterizes both; if the skin have a pungent feel, this too is indicative of scarlatina. In scarlatina the capillaries are generally congested, and the face and skin red; in diphtheria more frequently of natural color or rather pale. The constitutional disturbances are usually greater in scarlatina than in diphtheria. The throat in the former is more uniformly reddened, often presenting the appearance of a papillary eruption, which is not seen in diphtheria. Albuminuria may exist in either disease, and cannot be regarded as very significant. The rashes cannot be differentiated.

In diagnosing diphtheria from scarlet fever, the history of epidemic prevalence of either or both diseases, and of individual exposure, must be considered.

The diagnosis of diphtheria from membranous laryngitis or croup is often difficult. Usually the diphtheritic laryngitis is accompanied by swelling of the lymphatic glands of the neck, and is, moreover, often secondary in point of time to pharyngeal diphtheria. In croup the laryngeal affection is primary, and is not attended with glandular swelling. Sometimes, as in a case quoted by Smith, subsequent events may reverse the diagnosis. "A boy, aged two years and ten months, died of acute laryngo-tracheitis, lasting about four days. He lived in the suburbs of the city, where the houses were scattered, and where there had been no recent diphtheria. The case commenced with hoarseness, which gradually increased to a fatal obstruction in the air-passages, without any pseudo-membrane upon the fauces or upon any other visible part. The case seemed to be identical with the true croup with which we were familiar before the occurrence of diphtheria in New York; and yet it was diphtheritic, for two or three days after the death of the child, the two young women who nursed him, were affected with severe diphtheritic pharyngitis, with the characteristic pseudo-membrane."

Acute tonsillitis in its onset has many points of resemblance to the inflammatory type of diphtheria, as in both there is violent constitutional disturbance and acute inflammation of the tonsils. If the patient has been subject to quinsy, this fact will have weight in the decision of doubtful cases, as will also the prevalence of diphtheria in the community. The practitioner may be compelled, at best, to occasionally endure a few hours of doubt while waiting for diagnostic developments.

CHAPTER XII.

PROGNOSIS.

The mortality of diphtheria is without doubt exceedingly various in different epidemics, and is usually especially great in the earlier stages of its prevalence. In an epidemic which prevailed in France in 1847, the mortality is stated by Sir J. R. Cormack as 91 per cent.; in the first quarter of 1876, in the hospitals of Paris, as 79.75 per cent., and in the preceding six years as 76.54 per cent. According to authentic statistics of the Florentine epidemic in 1872 and 1873, 881 persons died out of a total of 1546 attacked, a mortality of over fifty-six per cent., which, Dr. Bergiotti remarks, should be regarded as rather the relation of the gravely affected to the dead, owing to incompleteness of the health returns and the probable omission of slight cases.

I know of no means of arriving with certainty at the average mortality of diphtheria. As already stated, it probably varies within wide limits. In Prof. Smith's report of cases in New York, the mortality was forty-seven per cent., of which he remarks, "The mortality of the cases embraced in the above table was probably larger than the average in New York practice, for several of them were seen in consultation, and their type was severe."

Dr. Ringer (*Boston Medical and Surgical Journal*, Oct. 6th, 1881), says, "According to the best statistics at hand, namely, those of our own city of Boston, two thirds of all reported cases recover, and the remaining one third die." With this Mackenzie agrees, saying, "It may, perhaps, be laid down as a rule that of the cases in which a definite membrane is present, one third, at least, will probably prove fatal." About the same rate of mortality was exhibited in the recent epidemic in the city of Brooklyn, N. Y. These rates accord with other American and European statistics, but are believed by the writer to be too high for a general average, which would probably range between twenty-five and thirty-three per cent.

Few epidemic diseases can be shown to be nearly so fatal, even after making the most liberal deductions from these ascertained rates of mortality.

Since fully adopting the chloral treatment in 1875, the author has treated upward of 400 cases of diphtheria, well characterized by false membrane, the only real diagnostic feature of the disease, with a loss of less than two per cent.

In the first stage of the disease the dangers are almost entirely from severe blood-poisoning, in which the patient is in danger of sudden death from the toxæmia. In the second stage we have in addition to the dangers of the first, those arising from extension of the membrane to the larynx, or diphtheritic croup, and also in its later stages from septicæmia from the absorption into the blood of the products of the decomposing exudation. In the former case the patient is in danger of death from asphyxia; in the latter from asthenia.

Infants at the breast are sometimes rendered wholly unable to nurse because of obstructed respiration. Such cases have been known to be fatal.

There is little doubt that in consequence of the diseased state of the kidneys, patients are sometimes destroyed by uræmia; the prudent practitioner should, therefore, carefully regard the character of the renal secretion in forming his prognosis. Again, in cases of marked debility, either from anæmia or any other cause, the heart's action is liable to fail. Debility, therefore, is an important element in prognosis. It is impossible to estimate the danger to be apprehended from thrombosis and embolism, which in severe cases may ensue at any period of the disease. Passive congestions and pulmonary œdema, also mainly due to debility or paralysis of the respiratory muscles, are not infrequently sources of great danger. I have several times known patients in these states to die as the immediate result of some exertion or excitement, as in opposing the administration of medicine, or in fits of anger.

Among the symptoms to be regarded as indicative of extreme blood-poisoning, and hence as unfavorable to recovery, are blueness of the skin, with coolness, if even only of the lips and extremities; extreme debility with pallor; anorexia and persistent vomiting; albuminuria, especially if accompanied by vomiting; implication of the nasal passages, denoted by stuffing or occlusion, with ichorous or fetid discharges, hæmorrhages, and feeble or obstructed breathing. If the cause of obstructed breathing be the invasion of the larynx by the specific diphtheritic processes, the prognosis is most unfavorable.

We should also regard a very rapid, a very slow, an intermitting, or an unsteady pulse as indicative of great danger; as also a very high or very low temperature of the body. In patients affected with scrofula or having a syphilitic taint the disease tends to become malignant, and therefore the danger of a fatal termination is extreme.

In any case having passed into the second stage, the danger is very generally in proportion to the extent and thickness of the false membrane. With adults, other conditions being similar, the prognosis is more favorable than with children, and for very obvious reasons.

During the period of convalescence, paralysis constitutes the chief danger, which cannot be said to be great, unless it extend to the muscles of respiration or to the heart, in which cases there is imminent peril.

In all cases of diphtheria the prognosis should be so guarded that the occurrence of dangerous conditions, which cannot be predicted by the most practiced physician, may not reflect distrust or discredit upon the profession.

CHAPTER XIII.

PATHOLOGY.

In general, during the first stage of diphtheria the fauces present the following appearances. The general mucous surface appears reddened, injected, and perceptibly inflamed. In malignant and secondary cases the color is more or less dusky. The tonsils are swollen, and often upon their surfaces are seen one or several elevated yellowish or grayish mucoid spots, about a line in diameter. The parotid, submaxillary, and often the cervical lymphatic glands are observed to be swollen. The uvula, too, in cases of considerable severity, is elongated and enlarged, and the submucous tissues are similarly injected. Within a brief period, a few hours to a day, from the beginning of the inflammation, the spots upon the tonsils or uvula lose their *equivocal* character, and become specific and significant, as well as diagnostic.

These patches gradually increase in size, become firmer and thicker from the exudation taking place beneath them, appear more dense and leathery, and constitute the *pseudo-membrane*, the characteristic product of diphtheritic inflammation.

When well formed and removed, this membrane has a somewhat felted appearance, or like the buffy coat of the blood. When handled it feels firm, is slightly elastic, and easily torn. If acetic acid be poured upon it, it swells and is rendered transparent. The caustic alkalies dissolve it. Chloral solutions partially dissolve it, and cause its speedy disintegration. It is insoluble in water and in alcohol, and to the former yields neither gelatin nor albumen, an indication of its *fibrinous* character. Its thickness varies from a mere pellicle to one-eighth or even one-fourth of an inch. Under the microscope it exhibits a fibrous structure with numerous bacteria and cellular bodies entangled or inclosed in its meshes.

These membranes are found intimately connected with the mucous and submucous structures upon which they are produced, and as shown before, can only be detached by considerable force or by the means of inflammation and ulceration. Occasionally the ulcerative process does not stop with the separation of the false membrane, but gangrene results, and contrary to the more ordinary rule observed in the process there is considerable loss of tissue. In many fatal cases the gangrenous process is exceptionally active, and its offensive odor and its destructive energy are rendered painfully manifest during life, as well as upon the post mortem table. The idea of the ancient physicians, that diphtheria was gangrenous *per se*, was however derived solely from resemblance of the membranous exudation to a slough. The gangrenous process may be, and doubtless is, generally aided or caused by the injection of the submucous tissues with fibrinous elements, resembling that which has exuded to form the pseudo-membrane, together with the use of violent local treatment.

"The exudation and infiltration sometimes compress the nutrient vessels of the part, and thus arrest the blood supply. Necrosis of the involved tissues results and leads to the formation of a slough, which is, in course of time, separated from the healthy parts. On the slough becoming partly detached there is left an open ulcer of various depth and extent." (Mackenzie.)

Smith attributes the result "to the presence and contraction of the *fibrin* with which the mucous membrane is infiltrated." In this manner are sometimes destroyed portions of one or both tonsils or the uvula.

The *mode* in which these membranes are produced will be readily understood by the following from Beale on Disease Germs: "The transparent colorless fluid which moistens the surface of a superficial wound after it has ceased to bleed, is poured out from the capillaries, or from the lymphatic vessels, or from both sets of vessels. This fluid, besides containing albumen in solution, contains multitudes of minute particles of bioplasm, which grow and multiply upon the surface. These form fibrin and matters more or less allied to it, and perform an essential part in the healing process, or in the formation of pus, as the case may be. These minute particles of living matter are present in the blood and lymph in countless numbers. They are concerned in the production of fibrous tissue outside the capillaries, which takes place in many pathological processes, and also in the production of pus-corpuscles, and other 'corpuscles' in the same situation, in disease. All exudations contain these particles of living matter. ——When the capillary vessels are distended, as in that extreme congestion which soon passes into inflammation, a fluid which possesses coagulable properties transudes through the stretched capillary walls. It is probable that in such cases minute and narrow fissures result, which, however, are too narrow to allow an ordinary white or red blood corpuscle to escape, but, nevertheless, wide enough to permit many of the minute particles of the living or germinal matter, the existence of which in the blood has been already referred to, to pass through. The small protrusions upon the surface of the white blood corpuscle might grow through the capillary walls, become detached, and pass into the tissue external to the vessels. Such minute particles of living matter external to the vessels, being surrounded with nutrient pabulum, and stationary, would grow and multiply rapidly, while a similar change would of course go on in the now stagnant fluid in the interior of the capillary. ———Some of these active living particles may be so small as to be invisible by a power magnifying 5000 diameters. I have seen such particles less than the 50,000th of an inch in diameter, and have no reason whatever for assuming that these are really the smallest that exist."

The bacterian bodies found in these membranes may be in great part derived from the blood, the tissues, or the air, in all of which under favorable conditions they are shown by this distinguished author to abound; and of the same varieties as that of which Eberth declared, "*Without micrococci there can be no diphtheria.*" Beale further states that he finds vegetable germs in every part of the body, and that they probably exist there from the earliest age and in all states of health; that millions are always present on the dorsum of the tongue and in the alimentary canal; that if in their *active* and not in a *germinal* state they be introduced among the living matter of healthy tissues they will *die*, although their minute *germs* which escape death may remain embedded in the tissues in a perfectly quiescent state.

Senator considers the minute round bodies described by Oertel as Spherical bacteria, to be the spores of the Leptothrix buccalis, and says the same fungi are found in diphtheria as in stomatitis. By other competent observers the bacteria of diphtheria are found in no way different from those observed in small pox, typhoid fever and vaccina. Although these bodies abound in the membranous exudate of diphtheria, their origin is not obscure, nor do they stand in a causative or other necessary relation to the disease.

These membranes, excreted from the blood, are shown under the microscope to be composed of fibrinous bands, in the spaces or interstices of which are found abundance of bacteria and numerous cells and granular matter as before stated. "No certain and invariable chemical or microscopical difference has yet been established between the pseudo-membrane of croup and that of diphtheria. The difference universally recognized is this: that while the croupous membrane lies upon the mucous membrane, and does not penetrate it, that of diphtheria, in the localities where it most commonly forms, namely, upon the buccal, faucial, and laryngeal surfaces, penetrates and becomes blended with the mucous membrane, so that it cannot be detached by force without the risk of injuring this membrane, and lacerating its vessels; moreover, by its presence in the mucous layer, it is apt to obstruct circulation in it and cause ulceration, even in the submucous tissue." (J. Lewis Smith.)

The septicæmia previously alluded to, most frequently occurs in cases in which, from decomposition of the membrane and the blood exuded beneath it, the exudate has assumed a dark color and become friable, causing ichorous discharge and fetor of the breath. Absorption of this diseased material causes inflammation of the lymphatic vessels and glands, or increased adenitis, which also occasions inflammation of the periglandular structures. On section the glands appear redder than natural with evident increase in their cell elements. The surrounding tissues are found infiltrated with serum and pus cells. The parotids and submaxillary glands are similary affected and frequently contain small collections of pus. The bronchial tubes are almost always more or less inflamed, and in some cases are the seat of membranous exudation which often extends to those of smallest calibre, and in these cases fibrinous bands extend into the alveoli, forming a network containing pus and at times blood corpuscles and bacteria.

The lungs are generally somewhat engorged and œdematous, especially at their bases. Pneumonia of a low type is also quite common, and may be either lobar or lobular, catarrhal or diphtheritic.

The heart may appear healthy, but in death from toxæmia its tissues are found soft and friable from fatty or granular degeneration, and of a color that has been compared to new leather, or coffee and milk. In some cases its chambers contain fibrinous coagula of antemortem formation, and a not infrequent cause of death. Similar coagula are found in the larger blood-vessels, blocking up the channels of the circulation. We cannot avoid again calling attention to the constant tendency manifested in diphtheria in almost every locality, to the coagulation of the fibrinous elements of the blood. The loss from the circulating blood of the fibrin abstracted by this coagulation within the glands and blood-vessels, as well as upon the surfaces of the body, greatly impoverishes it, and, with its impairment or decomposition within the bloodvessels, is chiefly the cause of its comparative incoagulability when abstracted by phlebotomy. Back of this lies, of course, in a causative relation, the original septicæmia induced by the subtle contagium generated in the body of some other person previously affected with the disease.

This great loss or destruction of fibrin robs the blood of its vital and nutritious properties, and in connection with other effects of the blood poison is doubtless the cause of the ever noted asthenic phenomena of the disease.

In 1872 Dr. Johnson, as quoted by Mackenzie, put forward, as the result of a careful comparison of many accurately recorded cases, the view that cardiac thrombosis is of very frequent occurrence in cases of diphtheria, and is a very fertile cause of their fatal termination. He also described in detail the physical signs by which its occurrence might be diagnosed during life. These views have been controverted by M. Collandreau Defreese, and the phenomenon attributed to antecedent cardiac disease, rather than to the diseased state of the blood; but be it observed that it is not in the heart alone the tendency to coagulation exists, but it is manifested also in the lungs, the glandular structures, upon the mucous surfaces, and upon wounds, and very probably throughout the vascular system; showing, in the author's judgment, the antecedence to belong to the blood and not to the heart. Again, this condition of the blood is shown in the earliest stages of the disease, before the period of cardiac complications or thrombosis is manifested, and is one of the evidences before noted of primary blood-poisoning in diphtheria, and points significantly to such hæmatics as remedies as are known to possess the power of preventing such coagulation and of thus limiting the formation of an exudation.

The brain manifestations depend largely upon the mode of dying. If death be from asphyxia, there are found venous congestion with minute extravasations of blood. Pus and lymph may be found upon its membranes in cases of severe toxæmia, and certain degenerative changes have been observed in the peripheral nerves and muscles affected by diphtheritic paralysis. M. Charcot found certain nerve cylinders, from a paralyzed palate, nearly or quite destitute of medullary matter, and to contain fatty granules of elliptic form, some of which were nucleated.

Neither the liver nor spleen have been shown to present any uniform lesions characterizing the disease.

The kidneys are more frequently found affected than any other internal organs, as from their anatomical situation and physiological function, as well as from the toxæmic character of the disease, they seem more exposed and overtaxed than any other viscera.

The blood in diphtheria, as before remarked, exhibits derangements, such as, from the disease phenomena noted, might reasonably be expected. From its necessary poverty of fibrinous elements it forms but an imperfect, soft, ill-defined coagulum. In cases of death by asphyxia from the laryngeal form of the disease, as might be inferred, it is blackish from excess of carbonic acid. Some observers have noted an undue proportion of white blood corpuscles in diphtheritic blood, as in other forms of asthenia, as anæmia and chlorosis. It has also been observed to show evidences of decomposition from the effects of the diphtheritic poison, by the abnormal accumulation of dark-colored debris. In many of the organs are found small exudations of blood, as already observed. These are most constant within the cranium, and are common in the lungs, the kidneys, and the spleen, and have been observed in the coats of the stomach.

"The most cursory study of the general pathology of diphtheria suffices to assure us that it is an acute general disease with certain local manifestations. The *primary septicæmia* is due to the specific poison, but absorption from the decomposing lymph is, no doubt, a cause of *secondary infection.* In all cases, the attack is associated with some degree of constitutional disturbance, while in the severest forms there is extreme disorganization of the blood, and consequent implication of nearly every tissue of the body. The general infection is shown at a very early stage, as well as at a period when the local manifestations have disappeared. Besides the constitutional disturbance, by which the attack is ushered in, there is the frequent derangement of the renal function, the marked prostration of strength, the functional disturbance of the heart, and, at a later period, the extensive implication of the nervo-muscular system. The local symptoms—the false membrane, with its parasitic growths—must be looked upon as the first (?) evidence of constitutional poisoning; in fact, as the first of the secondary phenomena." (Mackenzie.)

CHAPTER XIV.

GENERAL TREATMENT.

Having shown diphtheria to be, as defined in chapter I., an acute, infectious, specific, febrile, disease, depending primarily upon infection of the blood, manifested not only by general symptoms, but also by a peculiar and often dangerous specific inflammation; and having described the *type* and *course* of both, and the pathological phenomena they severally exhibit; and also the complications incident to the several types and stages of the disease, with their significations and tendencies; there yet remains for us to consider its treatment. This will be done under the heads of General, Therapeutic, and Prophylactic treatment.

The remarkable mortality hitherto exhibited by diphtheria under all the various modes of treatment hitherto practiced, amounting to from twenty-five to ninety-one per cent of the persons attacked, as estimated by several of the most trustworthy modern observers and authors (See Chapter XII), gives to this portion of our work peculiar interest and importance, and is a sufficient warrant and excuse for putting forward and defending the peculiar and novel mode of therapeutic treatment introduced by the author, and herein first given to the profession.

Without disavowing the ordinary motives prompting to research and labor, the writer distinctly claims the chief motive in view in giving these pages to the medical profession is a desire to diminish the sum of human suffering and the ravages of death from this fearful malady.

As diphtheria is a disease manifested by great depression of the bodily powers, the general treatment should be supporting. The patient should be placed in the best available apartment, which should be large, cheerful, well-lighted, well-ventilated, and well-warmed. As a general rule the temperature should be such as is most comfortable to the patient, and hence should be varied in different stages and cases to gratify his demands. The limits of variation may properly be between 60° and 75° F. When the larynx is invaded, moisture diffused in the atmosphere of the sick room is of signal benefit.

Whatever be the means of ventilation, keep the air pure and sweet, and its odor may be rendered agreeable by the use of pleasant perfumes. Keep the patient out of cold draughts.

The food must be not merely nutritious, but nicely prepared, fresh, and agreeably flavored. It may consist of sweet or buttermilk, eggs, tender beefsteak well hashed while raw, and lightly cooked, scraped beef, beef-tea or essence, egg-nog, milk-punch, soft cream-toast, rice thoroughly cooked, rice water, toast water, &c., and given regularly and frequently, day and night, in such quantities as are well borne. A little lime water (ʒ i *ad* ʒ ii to ℥ i) renders sweet milk, it is thought, more digestible. Food may be disrelished or swallowing very painful, still it should be given in some eligible form, or by enemata if that be the only available way. Most children will drink freely of cold fresh milk or buttermilk; if, however, it agree better, let it be warmed. If milk be taken freely, especially if a little raw egg with sugar be added, no fear need be entertained of want of nutrition. A high authority has recently stated, "There are few cases of diphtheria in which systematic feeding does not constitute the most important part of the medical treatment."

In cases of marked anorexia, or of continued nausea and vomiting, to force into the stomach large quantities of food only to be ejected, or that can at best be but sparingly assimilated, is dangerous and reprehensible, and hastens rather than retards the rapid emaciation, and lessens the patient's chances of recovery. This is true equally with adults and children. Among the latter are found many who, born to rule, have never been taught proper subjection to authority, and hence are, by most emphatic exhibitions of will, in the habit of controlling all about them by the force of unreasoning passion and resistance; and, also, the timid and over-sensitive class, who, from their loathing of food and medicine, painful deglutition, enfeebled powers, and unwonted surroundings, are bereft of their accustomed docility. Both these classes of children, when crowded by force, often resist absolutely necessary treatment with so great excitement and physical exertion as greatly and dangerously to exhaust their prostrate powers, thus increasing the imminent perils of disease.

Here arises a necessity for discrimination and the exercise of tact, often more potent for good than drugs, or even food administered unwisely or forcibly. Yield what is necessary in order to conquer peacefully. A little gratification of some longing desire, a little praise or sympathy well expressed, a little quiet repose, a firm look or word, or expressive gesture, or the exercise of any of the nice arts that spring spontaneously from the breast of sympathy or affection, will sometimes remove mountains of opposition, and are not to be neglected.

Make the necessary food and medicines as agreeable as possible; manage the patients well, and they will submit to necessary general or therapeutic treatment.

Sinapisms to the epigastrium or spine for older patients, or bits of lint or brown paper wet with chloroform or chloroform liniment and held in place with the hand a few moments, and, for *children,* spice poultices containing half a drachm of chloroform, are well borne and beneficial. A small glass of lemonade, iced or hot, as is thought best, or a litte freshly prepared tea or coffee are to be commended, as also are any aromatic mint or ginger teas. Recourse may also be had to the remedies advised in chap. XVI, or the formulæ appended to this volume.

In every case of marked debility, and such constitute a large proportion, the use of alcohol is indicated, in quantity proportioned to the condition and age of the patient. Three or four drachms of brandy or pure whiskey in twenty-four hours for a child of three or four years, given in punch or milk and egg mixture, may suffice in cases of only ordinary depression. In similar conditions an adult may take an equal number of ounces. Attacks of fainting, irregular, very slow, or very rapid pulse, sighing, great pallor or duskiness of countenance, or stupor or delirium, are each among the symptoms calling for a more liberal administration of this class of stimulants, regardless of body heat. If, however, in cases of high temperature with rapid pulse, these be increased, the stimulant is of doubtful propriety, and had better be diminished or suspended.

The character of the pulse should be carefully noted as one of the chief criteria in the use of any form of alcoholic stimulus. From the overwhelming effects of the severe toxæmia of diphtheria, manifested by feeble action of the heart, or the occurrence at any period of the disease of great exhaustion, it should be given *liberally;* in great emergencies, *unsparingly.*

The patient's clothing and that of the bed should be changed daily, and oftener if they become soiled, and excrementitious matter immediately removed. Time must be given the patient for sufficient sleep, especially during the night.

No persons except necessary attendants and unexcludable relatives should be allowed to visit the sick room. All unpleasant odors, especially from the kitchen, must be excluded, and the most rigid order and quiet enforced.

The patient should have a general tepid sponge bath once or twice a day, following which the skin, if hot and dry, may be rubbed with a little olive oil, to which may be added a few drops of carbolic acid or agreeable perfume. If the skin be too much relaxed, the bathing should be with alum-water and alcohol.

Other details of the hygienic treatment are omitted as needless for intelligent doctors into whose hands only, or chiefly, is this volume expected to find its way.

CHAPTER XV.

THERAPEUTIC TREATMENT.

An eminent writer says, "Few diseases more severely tax the therapeutic resources of the physician than diphtheria." Why? It is, as stated, because "he has to *devise* and carry out innumerable little details — hygienic, dietetic, and medicinal — which do not admit of description, and yet, upon the minutiæ of which, success or failure depend; because, too, of its various types and degrees of violence; and *mainly*, I apprehend, because the records of diphtheria disclose no authoritative, established, generally acknowledged, or even reasonably successful mode of treating the disease.

The diversity of the therapeutic measures advocated amounts to little less than confusion, and tends to beget the prevailing distrust of all authorities and all remedies, and to *drive* each individual member of the profession to trust himself to "*devise*," from his own resources, measures of treating the symptoms of each individual case as they may occur. It may appear to some to be a reflection upon medical science, to be so barren of acknowledged facts, as to be forced to such an acknowledgment in so vital a matter. Such, however, is not the fact. Medical science is not a revelation, like theology; nor demonstratively exact, like mathematics; nor so palpable as physics; but, like chemistry and electricity, has grown from the minutest germ, into a structure so stately as to rival all its contemporaries. In this stately edifice each stone is a golden fact, worked out from the quarries of eternal truth by patient research and careful observation.

From its very nature medical science can never be complete, but must be ever progressive, and this state of inharmony and unrest is only the earnest of progress. It is unreasonable to expect the votaries of this science to rest quietly in the presence of a mortality so appalling as is disclosed in the records of diphtheria. Inaction would be disreputable, non-professional, criminal. The search for a better, for a *specific* therapy in diphtheria will continue, despite the taunt of "a hobby," ignoring a blind deference to the dead past, refusing servile submission to the dogmas of the present, until the goal is reached, and the prize shines in the diadem of the victor, embellishes the great temple of medical science, and becomes a blessing to the human race.

All honor, we say, to Bretonneau and his compeers, the heroes of general and local blood-letting, of blisters, of caustics to the pharynx, and of mercury. Dr. Bard wrote, "But although I consider mercury the basis of cure, I do not by any means intend to condemn or omit the use of proper alexipharmics and antiseptics."

These authors of the past belonged, as leaders of medical thought, to their own day and generation, and not to ours, and if we judge them by our own standards we judge them unjustly, because the march of progress has been forward. Occasionally only, in this age, can be found an irrational advocate of mercurial treatment, whilst, with our better knowledge of the asthenic nature of diphtheria, the blood-letting and blisters, with all other depleting measures, we of the present day treat as madness. A few high names may still be quoted in advocacy of strong caustic applications to the throat, among whom we may mention West, Bouchut, Trousseau, Slade, Oertel, and Aitkin. Fortunately for the interests of humanity, as well as in honor of the medical profession, in obedience to the advancing sentiments of the age, these and all other violent measures of treatment are being abandoned.

With regard to the want of harmony in modes of treatment by different practitioners, J. L. Smith writes: "The wide discrepancy which exists in reference to the proper therapeutic measures, receives partial explanation from the fact of a wide difference of opinion as to the nature of diphtheria and its mode of commencement, but is more often due to the fact that statistics of its treatment afford very unreliable and often conflicting data, by which to determine the proper medicinal agents.

"For scarcely any other disease presents such a diversity in type as diphtheria, from cases so mild that nearly all recover, whatever the measures employed, to those so severe that a large proportion die under the best possible treatment, and this difference in type may be observed in cases occurring at the same time in a great city like New York, or even in the cases, which two physicians, practicing near each other, may be called upon to treat. Hence, one physician recommends with confidence a medicine or mode of treatment, as eminently successful in his hands, of which another physician of equal experience speaks disparagingly. The theory relating to diphtheria, which, in my opinion, has of late years done most harm, is that which attributes it to low vegetable organisms, visible under the microscope, which alight upon one of the exposed surfaces, usually the fauces, where they excite a local inflammatory action, and if not promptly destroyed, are apt to penetrate the tissues, enter the blood, and establish a constitutional disease. Acceptance of this theory evidently leads to the employment of parasiticide medicines, the so-called antiseptics, or antiferments, externally and internally, to arrest and destroy the vegetable growth, their local use sufficing, according to the theory, in the early stage, when these organisms have passed no further than the surface; but their internal use being required in addition, if the malady have continued longer, and the disease have become general."

Therapeutic treatment is divided into *local* and *general* or *constitutional.*

CHAPTER XVI.

LOCAL TREATMENT.

NUMBERS OCCURRING IN THE TEXT REFER TO THE FORMULÆ AT THE END OF THE VOLUME.

We have already incidentally alluded to the "savage energy" of the local measures advised by Bretonneau and others. The propriety of local treatment of its local manifestations is not to be questioned in diphtheria, any more than in other constitutional diseases with local manifestations, as in syphilis, scrofula, rheumatism, mumps. We must be careful, however, to put only a cautious and limited trust in our local measures, as some in use only increase the local irritation, and none are curative of the constitutional affection. Dr. Bristowe, in the *Medical Times and Gazette*, 1859, may be regarded as leading the modern sentiment on this subject.

He says, "1. That the throat affection is merely a local evidence of a constitutional disease, which is unlikely to be arrested in its progress by any treatment directed to the secondary manifestations only. 2. That the throat affection rarely kills, except by involving organs, such as the trachea and deeper tissues of the neck, which are beyond the region of the possible influence of such agents. 3. That if the theoretical correctness even of such treatment be admitted, the application of remedies to the surface of a thick false membrane, with the hope that they may affect the adjacent mucous tissue, is not only clumsy, but, as regards the object intended, practically useless; and that the prior forcible removal of the membrane from the entire surface, in order to their efficient employment, is unjustifiable in the early stage, even if possible, and is likely only to be followed by increased inflammation, and reproduction of false membrane. Of course, if a gangrenous state of the tonsils, or any other local complication, supervenes, such topical applications as are commonly had recourse to in like conditions of the throat should be employed."

Mr. Wade, in 1862, expressed the conviction that interference would neither prevent the reproduction of the false membrane, nor prevent its extension to the larynx. Greenhow's maturer views may be inferred from the following language: "I very soon discontinued this rough local medication to the tender and enfeebled mucous membrane. The propriety of this course became evident at the very first post-mortem examination I had the opportunity of witnessing, and has been confirmed by my subsequent experience."

Dr. Hartshorne recommends the use of hydrochloric acid and honey, equal parts, painted over the surfaces, or diluted and used as a gargle, also creosote in glycerine; lime-water; ice; and the inhalation of lime-water steam.

Aitkin advises warm fomentations externally, and the inhalation of water vapor with acetic acid: he also thinks a gargle, composed of a fluid drachm of diacetate of lead in eight ounces of rosewater, may be of service, but says gargles must not be persisted in if pain be caused by their use. "The tincture of the perchloride of iron is now fully recognized as having a beneficial local as well as general effect, and may be advantageously combined with quinine." He advises that the throat be syringed with a solution of perchloride of iron, and that the exudation be painted with a strong solution of the same, and also recommends a single efficient application of nitrate of silver, or equal parts hydrochloric acid and water, and considers useful a gargle of medicinal carbolic acid, one part in a hundred.

Cohen does not think highly of local applications or gargles.

Fothergill recommends the free use of nitrate of silver, as also do West and others.

Oertel, in Ziemssen's Cyclopædia, says, "In diphtheria we have to deal at first with an infection which is localized, and afterward with a general disease resulting from this, out of which may ultimately be developed still a later infection of various organs." As disinfectants, to be used with the atomizer, he advises chlorate of potash, salicilic acid, and, in the more advanced septic states, permanganate of potash. (See formulæ at end of volume.)

Prof. Smith says the object of local treatment is "to reduce the inflammation of the mucous surfaces, and destroy the diphtheritic poison, and contagious properties in the pseudo-membrane, and to destroy the septic poison, and prevent its absorption, if any forms. — — Irrigating applications, the use of the sponge or other rough instrument for making the application, should be avoided as likely to do harm." He advises the application to be made with a large camel's hair brush, or better, for most mixtures, with an atomizer.

In laryngeal cases he considers lime-water spray the most efficient, and reports seven recoveries in twenty-five cases thus treated. He advises the inhalations to be nearly continuous. For cleansing and disinfecting the nasal passages he advises Form. No. 8. A very excellent spray solution may be made by the mixture of lime-water and carbolic acid. Favorable effects are reported from dusting the affected parts freely with washed or sublimed sulphur.

Prof. M. Mackenzie writes, "In fact, the profession has given up the use of caustics altogether," and in regard to various astringent applications, as tannic acid, powdered alum, and tincture of the chloride of iron, "The disease is sometimes checked by this class of remedies, but on the other hand they sometimes irritate the throat — especially if there is much hyperæmia — and frequently increase the nausea and dislike for food which are so common. I now seldom use these drugs with the exception of iron, which when employed as a constitutional remedy also acts topically."

The objects had in view in the local treatment of diphtheria may be thus briefly summarized: 1st. Cleansing the mouth, throat, and air-passages; 2d. Disinfecting their secretions; 3d. Allaying inflammation by promoting secretion; 4th. The solution of the membrane or its detachment.

Two, three, or even all of these indications may be more or less perfectly fulfilled by a single remedy. Thus washing the mouth and throat thoroughly with warm water or weak solutions of chloral hydrate, borax, or chlorate of potash, purifies the surfaces, measurably disinfects the secretion, and promotes secretion and the detatchment of the false membrane.

But it is well known that sick children are very generally refractory, and by reason of perverseness, fear, or nervous irritability, or all combined, refuse to gargle, and resist any efforts to wash thoroughly the mouth, throat, or nasal passages. To force them into submission is to exhaust the strength and vitality, already, it may be, alarmingly depressed, and which are so necessary to any satisfactory treatment, and to recovery. Let there be no occasion given the little sufferers to either fear or fight their medical attendants or nurses — rather let them be coaxed, cajoled, or hoaxed into the use of the best available measures.

Some quietly submit to topical applications with a large soft camel's hair brush, which should be rinsed in hot water as often as it becomes loaded with the viscid secretions. For use in this manner or for gargling, formulæ Nos. 2 and 3 are specially recommended.

For cleansing and disinfecting the nasal passages when involved in the diseased action, inject three or four times a day the weaker solutions Nos. 6 and 7, or Prof. Smith's solution No. 8.

Avoid caustic and irritating applications, as they greatly aggravate the local mischief by coming unavoidably in contact with and destroying parts of the pharyngeal and laryngeal surfaces not yet invaded by the exudation, thus making new foci for the appearance and diffusion of the membrane; by impairing the ability to take nourishment, and, from the pain they occasion, engender opposition and strife on the part of the patient; and increase the absorption of septic matter.

No other local application has proven of equal value in my practice with *chloral hydrate*. I have used it constantly and exclusively for the last six years in every form of the disease, and in not less than four hundred cases, and can confidently affirm its great superiority, if not its specific control over membranous exudations, especially when used constitutionally at the same time.

In cases of but ordinary violence in which the air-passages are not invaded, the contact by gargling and swallowing, or simply swallowing the solution prepared for internal use hourly, prohibiting drink or gargling for five minutes after the administration, proves quite sufficient; both the local and constitutional symptoms beginning in a few hours to abate. The average duration of such cases has been about four days, exceptionally longer or less, with no other medical treatment. The ordinary sequelæ rarely occur to retard the convalescence in these cases, the proportion thus affected not being above two or three percent.

When the nasal passages are involved in the diphtheritic process, as evinced by the symptoms detailed, they should be carefully cleansed and disinfected by syringing with weak solutions of chloral every four hours. (Formulæ Nos. 6 and 7).

Regarding the topical use of chloral, Prof. Mackenzie says, "It was first recommended by Dr. Accetella, and subsequently by Dr. Ferrini, of Tunis, and has since been highly extolled by Dr. Cæsare Ciattagli, of Rome, and Dr. Massei, of Naples. In this country (England) it has been employed with great success by Mr. Hughes Hemming, of Kimbolton, to whom I am indebted for its recommendation. Mr. Hemming uses the syrup of chloral (grs. xxv in ʒ i) and directs that it should be employed every hour or two. It does not, as a rule, cause any pain, and the nurse can easily be taught to apply it. Mr. Hemming observes that 'whilst it rapidly gets rid of the fetor, it is beautiful to see the membrane loosen and come away, leaving a healthy surface underneath.' This remedy has also been very successfully used by Dr. Charles Hemming, of Bishop's Waltham."

The following testimony of the remarkable efficacy of chloral, topically applied, is borne by Dr. Rokitansky in the Medicinisch-Chirurgische Rundschau, Nov. 1878, as quoted by the American Journal of Medical Sciences, April, 1879.

"Dr. Rokitansky has used a 50 percent solution of chloral in three cases of diphtheria which had resisted the usual remedies, such as salicilic acid, carbolic acid, &c., and every time with the same results. The solution was applied every half hour with a camel's hair brush, and caused very little pain, except in one case where the tongue was thickly covered with a layer of diphtheritic matter; here a very considerable secretion of saliva was always observed immediately after the application, and the pain ceased entirely after a few moments. In the other two patients, in whom both tonsils were partly covered with the diphtheritic membrane, the pain was insignificant.

"After the solution had been applied three times, *i. e.*, one hour and a half after the first application, large pieces of the membrane could be easily removed with the brush. The underlying portion of the mucous membrane was red and covered with fine granulations. As soon as the normal tissue could be seen, weaker solutions of chloral were gradually used during a week, at the end of which the patients had entirely recovered."

I have rarely used for the last five or six years any other topical treatment within the throat, and therefore feel qualified to indorse the preceding testimonials of its remarkable efficacy, and to recommend chloral for this purpose as more effective than any other remedy. According to my observations it will not only cause a rapid separation of the false membrane in mass, but so act upon it also as to cause its disintegration, thus depriving it of its structural character and much of its power for mischief. In this manner the exudate can often be defibrinated as fast as transuded, and its membranous or structural character be prevented.

Its local application should be by means of a soft pencil of camel's hair or a feather, and when the constitutional treatment is also by chloral, and timely, will seldom be required and need never to be repeated more than two or three times a day, and in strength of from twenty to fifty per cent.

The patient, if it be agreeable to him (but not otherwise), may be allowed to take small pieces of ice frequently into the mouth as a means of allaying thirst and morbid heat and dryness. It is thought by some also to have the effect sometimes of reducing the local inflammation and swelling about the fauces. This, however, there is ample ground to doubt, and when we consider the nature of the disease, and the peculiar low grade of the inflammation, there is good reason to fear harm from its effects upon the obstructed capillaries of the parts, by causing in them a decrease of the already low vitality; and also by favoring further fibrinous coagulation within the capillary walls, and in the contiguous cellular and glandular structures.

The external use of ice by means of ice-bags applied to the neck, although reputably indorsed, for the preceding and other self-evident reasons, can only be potent for evil, and is unwarrantable.

Poultices and fomentations are also advocated by many physicians, but in my observation have not proved highly beneficial except in laryngeal cases, in which they are of great value when carefully applied. The use upon the neck of large slices of fat pork is also recommended, but is regarded by the author as not only useless and filthy, but mischievous. The neck should in all cases be enveloped in several thicknesses of soft, dry flannel. If there be much adenitis and cellulitis, the most efficient application is, in the author's estimation, a combination of equal parts of tincture of iodine, glycerine, and a fifty per cent. chloral solution, with which the swollen and inflamed structures are frequently to be thoroughly painted; and always to be kept well protected from the air by means of several thicknesses of soft, dry flannel, as before mentioned.

CHAPTER XVII.

CONSTITUTIONAL TREATMENT.

The experience of the medical profession in the treatment of all general or constitutional diseases warrants the assumption that it must be largely addressed to the general system through the medium of the blood. If the blood be not itself the sole seat of disease, it must at least be the bearer of the disease germs, and must be made to carry most remedial agents, whether antidotal or recuperative, to the invaded structures. Diphtheria has been shown to be a general disease of the blood, exhibited only incidentally, although with surprising uniformity, by local manifestations. Primaily it is to be regarded as a *blood disease* only, manifested first, or during the stage of incubation, by very slight derangements, or none at all. The system is poisoned by the infection derived from some person previously diseased, and the poison is "working," but is endured without manifestations or complaint up to a certain degree, when it is distinctly declared by symptoms, systemic and local. This period is rather illogically called "the attack."

The treatment of diphtheria has been and still is, to most practitioners, exceedingly miscellaneous and unsettled, as well as unsatisfactory. The following quotation expresses truthfully the general sentiment of the profession on this subject. Prof. Lennox Brown, F. R. C. S., writes as follows: "Many general remedies have been suggested, and some have been vaunted as specifics, but the most rational and satisfactory method seems to be that of treating symptoms as they arise..... Those who look on the disease as occurring under circumstances similar to those producing erysipelas or phlegmonous sore throat; and especially having regard to its remarkable tendency to produce anæmia, as well as its extremely asthenic character, will be disposed to give perchloride or other forms of iron; others who may consider the poison of diphtheria allied to that of scarlatina, will prefer to rely upon cinchona with acid or ammonia; other practitioners, again, may be more willing to depend upon the sustaining properties of strong and easily digested nutriment, with the moderate use of diffusible stimulants. Seeing how unsatisfactory the results of drugs are in this disease, it certainly does not appear desirable to push nauseous, and often not easily assimilated medicines, in a disease so prevalent among young children, who in addition to having a natural dislike for medicines, experience great pain in attempts at deglutition."

Mackenzie says, "There are few cases of diphtheria in which systematic feeding does not constitute the most important part of the medical treatment." Prof. J. Lewis Smith says, "It is remarkable that there is so little agreement in the profession in regard to the medicinal treatment of diphtheria, since this disease has now been under almost constant observation during the last twenty years in the principal cities of this country, and many epidemics have been closely observed and reported by intelligent physicians in the rural districts."

In the presence of the prevailing professional sentiment regarding the therapeutic treatment of this disease, so elegantly and truthfully expressed in the above quotations, which fairly represent the diversity of opinions, or positive antagonisms existing among medical practitoners and writers on this subject; to dissent to the views or practice of eminent medical authors is neither discourtesy nor professional heterodoxy. On the contrary, this condition invites research, observation, experiment; a struggle for new light to supplant the confusing darkness; and imposes on physicians an imperative duty to report to their brethren the discovery of any new plan of treatment or new remedy, which, supported by sufficient experience, and success on trial, furnishes a basis for a true faith, and a consistent uniformity, or at least similarity, in the means employed.

The writer comes before the medical world with a new book not merely containing a rehash of what *has* been said or written before on this subject, (although the writings of others have been searched, freely quoted, contrasted, and weighed; and in the department of therapeutics mainly rejected on account of their want of specific practical value); but he appears in these pages as the herald of a new departure, which is not new in the sense of being untried or unproven; and as the advocate of a *specific treatment* of the membranous diseases by a remedy which has championed its way to his full confidence by the exhibition of such remarkable power in diphtheria as to have reduced its mortality to a percent not greater than that of malarial fever when treated with its specific, quinia. It is hardly necessary to say, after what has been already written, that this remedy is *chloral hydrate.*

It is not used to the exclusion of such other rational remedial measures as are indicated by the symptoms, nor such as are believed to aid its specific action. Before detailing the mode of administration and its supposed modus operandi, it seems best, in order to a full view of the subject in hand, that we should cursorily pass in review the remedies in most general use; that each may be, as nearly as possible, assigned its appropriate sphere by the practitioner; and also to give to the student a correct but condensed view of the entire literature of the disease.

Cathartics. The operation of an efficient laxative in diphtheria is not open to the objection of Dr. Slade, based upon the idea that it increases the asthenia. Quite the reverse is the fact if the remedy be properly selected and its effects limited within reason. By its operation we not only relieve the plethora and the fever, but by promoting the secretion may reasonably hope to eliminate from the system some portion of the specific virus of the disease.

The weight of authority in this matter is on the side of reason, in favor of the administration of a prompt efficient laxative as early as possible in the disease, unless contraindicated by some such conditions as diarrhœa, unusual debility, or extreme malignancy, all of which must enter into the account of the attending physician in adjusting his treatment. Sir Wm. Jenner and Dr. Aitkin advise calomel and jalap for this purpose, or a calomel and colocynth pill, followed in the inflammatory forms of the disease by a saline aperient. My practice is to give from five to fifteen grains of calomel, according to age and conditions, combined with an equal or greater weight of bicarbonate of soda, and followed in three or four hours, if by that time it have not moved the bowels sufficiently, by a draught of Rochelle salt, a portion of castor oil, or an enema of tepid salt water, or soap suds.

Emetics, although of doubtful utility, are often employed in diphtheria for the purpose of effecting the detachment and expulsion of the false membrane, and are thought by some to be of especial value when the larynx is involved in the diseased process. If in such cases they prove beneficial, it must be mainly by causing maceration of the false membrane by the free secretion of mucus about and beneath it, aided by the vomitive effort induced for its expulsion. Mucus is not known to be a solvent of the exudate, nor is it by any means certain that its presence greatly accelerates its separation. It is, however, generally abundant in the throat when it is the seat of the deposit. A loosened membrane or one but partially detached by the physiological process, and irritating or obstructing the larynx and glottis, is not infrequently expelled by the vomiting caused by its presence in such localities, and when such a state of the membrane is known to exist and does not occasion the necessary vomiting, it is reasonable and proper to cause it by irritating the fauces with a feather or the finger carried far back into the throat.

The debilitating effect of antimony and ipecac, especially the former, is well known, and their use is therefore not to be thought of in states of prostration such as are usually seen in diphtheria. Even the exertion of vomiting, in cases of great debility, is to be feared, and avoided if possible.

If in any emergency, the use of an emetic seems imperative, the patient should be guarded from harm by being previously placed under the influence of an alcoholic stimulant, or a supporting dose of morphia (one sixteenth to one sixth of a grain), or both combined; and even then it will be necessary to select only such emetics as act quickly and briefly. Those least objectionable are, doubtless, powdered mustard seed in doses of one or two teaspoonsful in a wine-glass of tepid water, and the sulphates of zinc and copper.

The *copper* salt may be given in doses of from two to ten grains, mixed with powdered sugar, every ten or twelve minutes until it acts: the *zinc* dissolved in tepid water in doses of ten grains for children, to sixty for adults, and may be repeated in five minutes. Bretonnau, for reasons given, preferred the copper; J. R. Cormack advises the zinc. Opinions differ, and the practitioner has abundant authority for his choice. About the only valid reason that can be assigned for the administration of an emetic in diphtheria, let it be understood, is to get rid of the annoyance and danger of detached or partly loosened membranes irritating or obstructing the larynx. They are not believed to occasion its loosening if given before that process is at least partially effected through the ordinary process of inflammation.

The *tincture of the perchloride of iron*, and *quinine* are the two remedies more generally employed at the present time than any others, though upon what principle it is not easy to decide. They are variously classed by writers as tonics, restoratives, specifics, recuperatives, and antiseptics, or as belonging to two or more of these classes.

From the fashion in the medical profession at the present time of prescribing one or both of these valuable remedies in every case of diphtheria and in every stage, it is necessarily inferred that they are regarded as specifics. They are prescribed as uniformly in this disease as are any of the known specifics in the diseases they are known to arrest. If judged in this light, in view of the slightly diminished rate of mortality since the times of Bard and Bretonnau, with bleeding, mercury and blisters, they must, with these discarded remedies, be regarded as flat failures.

Among a respectable minority who regard iron as possessing no special utility in this disease, West, in his Diseases of Children, has the following: "Neither have I found it to vindicate in my hands its claims to that special specific virtue for which some practitioners have given it credit." Flint, in his Practice of Medicine, speaks most decidedly on this subject, saying: "The tincture of the chloride of iron does not exert a specific influence as some have supposed."

If it is not as a specific that iron is prescribed, it is probably as a restorative tonic. Here, in diphtheria, markedly in its early stages, the acknowledged indications for its administration are usually noticeably lacking. M. Bretonnau wrote in 1826: "At the onset of diphtheria the organic functions and those which belong to the life of relation, are so little disturbed that children who are already dangerously affected by malignant angina, generally retain their habitual appetite, and continue their play"—an observation very applicable to numerous cases at the present time. The nutritive fluid is not impoverished, as the appetite and digestion are as yet but slightly impaired; neither anæmia nor emaciation being manifest, but only such depression of the vital powers as results from the toxæmia. The rational indications in this condition seem rather to call for nutrients and alcoholics, or specifics, to fortify the system against the progressing ravages of the disease, or to counteract and eliminate its virus, than for iron as a restorative. It is not rendered even probable by the state of the patient that the blood is suffering from any want of iron in the composition, but as before intimated, from the effect of a specific poison for which iron is not even claimed to be an antidote. This systemic condition calls for support till the disease is overcome by the recuperative energies and its germs eliminated, or else for specific treatment, and *iron* quite certainly meets neither of these requirements.

I am permitted to make the following quotation from an unpublished thesis of an esteemed medical friend:

"The tincture of the chloride of iron is by many regarded almost if not quite in the light of a specific in diphtheria. Its admirers and upholders, aside from considering that it destroys or neutralizes the specific poison to which the disease is due, advocate its use on the ground that it is a tonic, an astringent, an appetizer, and an antiseptic. All of these qualities, except that of a specific, the remedy under consideration most unquestionably does possess. Its action as a specific is certainly not well supported. As a tonic and restorative, iron is unquestionably one of the best. It is one of the great triad of restoratives, quinia and cod-liver oil being the other members. But is tonic and restorative action required, as a general thing, thus early in diphtheria? And when required, is iron the best agent to employ? The patients are generally young and vigorous, often plethoric, and tonics are often strongly contraindicated. And when required, beef-juice, eggs, milk, cream, egg-nog, and nutrients generally, fulfill the indications better than iron.

"As an astringent, tincture of iron has the same properties as Monsell's solution, intensified in degree, and is more irritating. In common with astringents as a class, it checks secretion by constringing the mucous surfaces with which it comes in contact. But in diphtheria the indication is to get increased action of the mucous glands, as the restoration of the normal secretion facilitates the separation of the pseudomembrane; and astringents are contraindicated.

"The mucous glands under the membrane are either acting abnormally, or not acting at all. This perversion or suspension of their function must be rectified, and the normal secretion restored if we would imitate our great teacher, Nature, and favor the separation of the pseudo-membrane in the natural manner. And in the inflamed condition of the throat the local application of an irritant is anything but beneficial. As an antiseptic it does not rank as high as many others that are far less irritating in action.

"Appetizers are hardly needed in the commencement of the malady, and in children, with whom we have most frequently to deal in treating this disease, the tincture of iron, by its disgusting taste, begets a loathing rather than a longing for food. Its exhibition is pushed in diphtheria; full doses frequently repeated being the rule. But no less an authority than Pareira says that when swallowed even in medicinal doses it readily disorders the stomach. Hence it defeats its own object.

"In diphtheria the fever is often very marked, and there is a tendency to fibrinous deposits not only in the throat, but in the cavities of the heart, and embolism is not infrequent. Iron certainly will not abate the fever, and is not known to have any power to arrest membranous, or to prevent or arrest fibrinous coagulation in the chambers of the heart and the blood-vessels, and therefore is not indicated. After the high fever has passed away and the vital forces of the patient are very low, seems to be a more reasonable time for the employment of this remedy. And there are arguments against its use even here. In Wood's Materia Medica we find the following: Analogy has suggested its employment in other adynamic affections, such as diphtheria and pyaemia, but its value in these diseases is much more than doubtful.

"According to Stille, iron is contraindicated in congestion and inflammation, which would go to exclude it from our list of diphtheritic remedies.

"Iron is generally administered in large and increasing doses, from the first to the last visit of the attending physician, to adults in doses of ʒ ss to ʒ i every two or three hours diluted with water and glycerine, and to children in proportionate doses; or the following to a child of five years:

℞ Tinct. ferri chloridi,
Potas. chlorat. *aa* ʒ ij,
Syr. simp. ℥ iv, *misce.*

A teaspoonful every one or two hours. (Smith.)

These doses are often considerably increased. If the case be malarial or malignant, quinia and whisky are far more rational."

Quinia may be sometimes required as indicated, but is neither known nor supposed by the writer to possess any peculiar therapeutical properties that render it any more efficacious in diphtheria than in any other febrile disease in similar conditions. Its great value as a remedy has led too many practitioners into its indiscriminate use in the most diverse and contradictory conditions, apparently upon no well settled therapeutical principle; but as being the first thing to suggest itself as possibly possessing some indefinable property to meet almost every emergency, local or general, acute or chronic, that may occur in practice.

The very general administration of quinia in this disease can only be accounted for, first, from its being regarded as a specific. This deduction seems almost a necessity, as it is given, as is iron, early and late in the disease; when symptoms are sthenic or asthenic; adynamic, malignant, or benign; laryngeal, nasal, or faucial; and with the same uniformity with which it is given in intermittents, for which it is an *acknowledged specific;* or second, for its supposed tonic properties, in view of which it may at times be beneficial. Be it remarked, however, that no small proportion of the cases of diphtheria are characterized for the first twenty-four or forty-eight hours by high arterial action and a corresponding increase of temperature, and that the effect of quinia in ordinary medicinal doses is to increase the heart's action and the body heat. It is consequently more rationally prescribed in states of great exhaustion and debility. Any means which, in these sthenic states, has so direct a stimulating effect, cannot be other than hurtful, as the high action is a chief agent in consuming or exhausting the vital powers, which at this stage should doubtless be conserved by a cautious lowering of the temperature and calming the circulation by tepid sponging, or a few doses of aconite or veratrum in connection with the chloral treatment.

Two to four grains of quinia every two or three hours in such sthenic states, which is common practice, theoretically should be, and doubtless is, pernicious. If given at all in such states it should be in anti-pyretic doses of ten grains to a child of five years, and twenty or thirty grains to an adult, and promptly suspended, if, at most, two or three doses at intervals of three hours do not effect the desired reduction in body heat and pulse rate..... Quinine may be given, third, as a mere matter of routine, or a blind concession to writers whose recommendations are regarded as sufficient warrant for the practice. Quinia is a most valuable remedy, as are also mercury and atropia, but it does not follow that they should be given to all persons in all diseased conditions. Their power for good, when indicated, is no less potent for evil when contraindicated. What, for example, can be expected from such practice as the following, reported, but not sanctioned, by Prof. J. L. Smith in the immediate connection with the remark "that quinia does not exert any special or peculiar action in diphtheria, and is beneficial in the same way and no further than in other acute infectious diseases, is, I think, generally admitted by the profession; for large doses do not exert that controlling effect, which we would expect from a specific, as is shown by cases like the following, which are not infrequent during severe epidemics:

"C. aged four years, male, was examined by me in consultation, on February 10th, 1876. I learned that he had apparently contracted diphtheria from the escape of sewer gas through a defective trap in the little room where he slept, and that the disease began after midday on February 6th, with fever; at 10 P. M. of the same day, when visited by the family physician, the temperature was 103°, and the fauces were red, but without any pseudo-membrane. Four grains of quinia were ordered to be given every two hours, and ten drops of the tincture of the chloride of iron, with two grains of the chlorate of potassa, to be given three times hourly. On the 7th the exudation covered both tonsils and the half arches; temperature 102½°; evening, temperature 100°; pulse 128. 8th, is playful; pulse 100; has slight swelling of the cervical glands; evening, some extension upward of the pseudo-membrane; has vomiting. 9th, Pulse 144; vomits often. 10th, at 3 P. M. began to grow worse; phanynx and nostrils covered with exudation."

Forty-eight grains of quinia and one and one half ounces of the tincture of the chloride of iron a day for four consecutive days to a child of four years, or a total of 198 grains of the former and six ounces of the latter!! What physician will wonder that, with the recuperative powers so weighed down and embarassed with such an amount of nauseous drugs, the little one should grow worse day by day, should vomit on the third day, and die on the fourth of "toxæmia?"

"Drugs are medicines when they cure,
But poisons when to death they lure."

Prof. Smith in commenting upon this case says:

"It was impossible, at the time of my visit to obtain any of the patient's urine for examination, and death occured a few hours afterward from the toxæmia. Forty-eight grains of quinia administered daily, from the first day, had no appreciable effect in staying the fatal progress of the malady, had no such effect as would be likely to follow, were its action specific or antidotal. But there are two advantages from the quinia treatment, which explain the confidence reposed in it by the profession : 1st. It has an antipyretic effect in doses of from three to five, or more, grains. 2d. In moderate doses it is one of the most reliable tonics. But high febrile movement, requiring an antipyretic, I have seldom observed in diphtheria, except in the first forty-eight hours ; and if, during this time, the febrile movement be such that an antipyretic is required, quinia in the large doses is preferable, in my opinion, to any other remedy. In its subsequent use, namely, as a tonic, two grains may be administered every two to four hours. But other bitter mixtures, which have been found to be the most useful tonics in general practice, perhaps would meet the indication nearly or quite as well."

In the history of medicine no remedy has been so much abused, or brought into such undeserved discredit by its advocates, as quinia ; if only we except mercury and blood-letting, the panaceas of the age just past. "It will certainly cure malarial intermittents, and hence, as they are febrile diseases, it is probably remedial in all other fevers," is a process of reasoning that answered well enough for the facile quack who, after failing to cure his ague by lobelia et al, was forced by suffering, against what he thought his better judgment, to resort to quinia, and being promptly cured, became so strongly converted that he not only prescribed it for every disease, but adopted it as an article of diet, and daily sprinkled with it his potato and bread-and-butter. Such a philosophy is quite too prevalent, as is easy to see, in the practice of some regular physicians. An army physician once prescribed quinine for a subordinate afflicted only with a sore toe. Such aimless, senseless, routine practice may not often endanger the patient, but is certainly a reproach and disgrace to physicians so afflicted with mental or moral stupidity.

As a general tonic the claims of quinia, although strongly contested, are for the present conceded ; and hence we regard it as remedial in states incident to diphtheria, but know of nothing entitling it to rank here as a specific. "As a rule, however," says Mackenzie, "quinia is more useful after the more serious symptoms have abated, when it may be very suitably combined with iron and a mineral acid. Morphia and chloral are occasionally necessary to combat continued sleeplessness, and to ward off the exhaustion which is its invariable consequence."

Chlorate of Potash. This salt, usually classified among diuretics, has since its introduction by Hunt in 1847 for the treatment of cancrum oris, achieved a cosmopolitan reputation in the treatment of ulcerative diseases of the mouth and throat. Many practitioners hold that it, as well as chloral, possesses aplastic powers, or the property of checking the formation of an exudation, and it is doubtless more generally prescribed in croup and diphtheria than almost any other remedy. West is said to have been the first to formulate its use in membranous stomatitis, which occasionally exhibits pseudo-membranous patches on the gums and buccal surfaces. We do not, however, class ulcerative stomatitis among the membranous diseases. Subsequent observers have not only confirmed the favorable reports of Dr. West, but have conferred upon this remedy the character of a specific in the treatment of this hitherto refractory affection. Its mode of action is not understood, but its almost universal efficacy in ulcerative stomatitis is one of the few established facts in clinical medicine.

Having achieved such a reputation, how naturally comes the suggestion to test its utility in other diseases more uniformly attended with membranous exudation. Bluche is supposed to have been the first to try its efficacy in diphtheria. The results were not as emphatic as in ulcerative stomatitis, but were encouraging. " Since then, cases have multiplied in all quarters, and the facts authorize us to consider chlorate of potash, as a remedy, perhaps not sure, but at least able to render some service in this grave disease. But in this respect we must make an observation. Croupous angina (diphtheria) has very various degrees of gravity, according as it appears sporadically or as an epidemic, and it would be supremely irrational to draw conclusions from therapeutic experience in cases so unlike. If it is true that in malignant angina, especially when epidemic, chlorate of potassium generally fails, as most treatment does fail, it cannot be denied that the same remedy has procured success in quite different circumstances, that is, when croupous angina presented chances of curability. In this respect the observations made at the children's hospital, or published by a large number of physicians at Paris and in the country, scarcely permit a doubt. We will say, then, with Isambert, that the usefulness of chlorate of potassium, in cases of medium intensity, seems to us proved, not only by a real and definite success, but by its special and almost elective action upon the pharyngeal mucous membrane, identical with that which is observed in membranous stomatitis. The return of the rose red color, the fall of the false membranes, the lowered pulse, are often in a space of time which is sensibly the same in both cases. This observer adds that cauterization, employed concurrently, does not seem to him to hasten the action of the chlorate at all, but sometimes to impede it." (Trousseau.)

In as much as clinical facts are more to be trusted than the most elaborate theories without such confirmation, and as like testimony to the utility of this medicine in diphtheria is borne by nearly all observers, everywhere, it must be accorded a place among the tried and useful remedies in diphtheria. Its *dose* is from two to ten grains, in aqueous solution, every hour, and should be given in conjunction with from one to five grains of chloral hydrate. (Form. Nos. 22 & 23 at end of vol.)

The internal treatment of Dr. J. L. Smith, which is very generally followed by American physicians, is the administration in alternation of formulæ Nos. 19 & 20, which he declares he has found to constitute the most satisfactory internal treatment. He also advises citrate of iron and ammonia, alone, or in combination with carbonate of ammonia, in two grain doses, dissolved in simple syrup, in place of the latter, when the inflammation of the fauces has considerably abated, or is moderate. As a disinfectant to be applied within the nostrils, he advises carbolic acid, gtt. xxiv, glycerine ℥ ij, and water ℥ vi; to be injected every four hours. Also lime-water spray in laryngeal cases.

Mercury was considered by Bretonneau and others as the most important of remedies in the constitutional treatment of diphtheria, and Dr. Bard wrote "Although I consider mercury the basis of the cure, especially in the begining disease, I do not by any means intend to condemn or omit the use of proper alexipharmics and antiseptics."

Very few practitioners of the present time prescribe this agent in any other way than as a laxative in the early stages of the disease. Its specific effects are now known to increase the asthenia and adenitis, without any compensatory effect to neutralize or to eliminate the specific poison; hence mercury is practically and deservedly expunged from the list of anti-diphtheritic remedies.

Sulphide of potassium, regarded by Swiss physicians as a valuable specific, probably does more harm than good, and is only mentioned to be condemned.

Bromine and the *bromides* have also failed to vindicate the expectations of their advocates, and are practically abandoned except in laryngeal cases.

Carbolic and *salicylic acids*, and the *sulphites* have been vaunted since the promulgation of the bacterian theory, as constitutional as well as local remedies of great value for the destruction of those minute low organisms of which Eberth has said: "Without micrococci there can be no diphtheria." These remedies, or some of them, doubtless do possess in a high degree, bactericide properties; and, were the theory true, would be genuine specifics for diphtheria, at first locally, and afterward systemically, through the medium of the blood. These remedies I have formerly often used very early in the disease, both locally by careful application to the entire inflamed faucial surfaces; and internally, either at the same time or subsequently, without any apparent modification of the progress of the disease. Other observers have had similar experience of their inutility. J. Lewis Smith expresses himself upon this point as follows:

"But experience, if sufficiently extensive, is the safe guide in therapeutics, and, according to my observations, internal antiseptic measures have not seemed to exert any marked controlling effect on the course of diphtheria."

As bearing upon this subject he refers to a case of a four years old child, who took "Almost from the beginning of the sickness, a mixture of potassa and iron on the first hour, two grains of quinine on the second hour, and three grains of salicylic acid on the third hour, and this treatment was continued night and day, and yet this child, having from the first taken sixteen grains of quinine, twenty-four of salicylic acid, beside the potash and iron daily, died after eight days with profound blood poisoning, having had many extravasations of blood."

Mackenzie says: "I have not employed carbolic acid myself as an internal remedy, but the sulphocarbolates as recommended by Dr. Sansom have often proved of service in my hands, in the *secondary* poisoning of diphtheria. In the *primary* septicæmia, these remedies have appeared to me quite useless." (Form. No. 26.)

Balsam of copaiba and *cubebs*, so well known for their action on the mucous membranes, have been used both as specifics and as expectorants in diphtheria, and are well spoken of by very reputable observers. Mackenzie says: he has found distinct benefit in catarrhal cases from perles of copaiba, but is of the opinion that neither copaiba nor cubebs can lay claim to anything like a certain and specific action. Dr. Beverly Robinson, one of the physicians of Charity Hospital, New York, following the teachings of Trideau, is an advocate of the treatment by freshly powdered cubebs, (*American Journal of Medical Sciences*, July, 1876.) Its action he considers to be that of a stimulant to the mucous surfaces, both by contact, and by elimination through the respiratory mucous membrane and the kidneys. To a child of five years he gives gr. x in sweetened water every two hours.

Senega alone or in combination with carbonate of ammonia, has also been found useful, probably by promoting secretion by the mucous and salivary glands. By increased secretion beneath the false membrane its separation may possibly be promoted, and the pharyngeal congestion in some degree relieved.

Of expectorants it has been said no other is equal in efficacy in diphtheria to *pilocarpin*. Dr. Guttman, of Cronstadt, has recently treated sixty-six cases with this remedy, with most satisfactory results. "Fifteen of these exhibited the worst symptoms of diphtheria, of which at least two-thirds, according to previous experience, would have died; thirty-three bad cases had extensive membrane, the others slight. He gave pilocarpin to all, and in the first cases associated this treatment with quinine and gargles only, they recovered in periods, as a rule, varying from twenty-four hours to three days; of the fifteen worst cases, two recovered in nine and eleven days, the rest in two to five days. All patients who came early under treatment, while the pseudo-membrane was still loosely adherent, without exception were cured in twenty-four hours. The doubt that these cases were not truly diphtheritic is not to be raised, since they were examined with the utmost care, and, in the worst cases, the contagion could be distinctly traced. Under the action of pilocarpin not only were the membranes and infiltration dissolved in the salivary flow, but also the violent inflammatory condition yielded to its influence, the deeply reddened, dry mucous membrane soon became moist, pale red, and in every respect of normal appearance." (*Boston Medical and Surgical Journal,* Oct. 6th, 1881.)

For his mode of administering the remedy, see formulæ 27 and 28, each dose to be followed by "a small amount of generous wine." Others who have used this remedy in a similar manner report favorably of its effects.

An eminent American author (Flint) has asked the following simple question: "*Is there any known specific remedy for this disease?*" and replies that "the question must be answered negatively, unless we give credence to the doctrine advanced by Dr. E. W. Chapman, namely, that the special morbid condition of the blood is antagonized by alcohol. Dr. Chapman claims that by the early administration of alcohol, as freely as it is tolerated without alcoholic excitation, in conjunction with quinia, the disease is curable. He bases this doctrine on the results of a pretty large clinical experience. He employs alcohol, not as a sustaining remedy, but as an antidote, comparing its efficacy to that which it has in cases of venomous snake bites. The claim in behalf of this method of treatment is not irrational, and it should be tried sufficiently to test its value. To the usefulness of alcohol in the treatment of this disease the author (Flint) can add his testimony to that of others. The tolerance of alcoholics is, in some cases, notably increased by the disease. It should be given to the extent to which it is tolerated without any manifestation of its toxical effects. The novelty of Chapman's doctrine is that its utility depends on its antidotal effect, and that, therefore, the earlier in the disease it is given, it is better, not waiting for evidence of failure of the vital powers. A French author, M. Sanne, considers alcohol the most effective of antiseptics which are administered internally, and that it is indicated in proportion to the intensity of the infection."

It is believed by the writer that the experience of the medical profession thus far, fails to support the claims set up for alcoholics to antidotal or specific virtues in diphtheria, and that they are only of value as in other asthenic diseases or exhausted states of the bodily powers. Under such conditions of prostration as often occur in diphtheria their exhibition is imperative, but not more so than if the cause be typhoid fever or any other exhausting disease. The symptoms believed to indicate, and which should govern their use, are given elsewhere in this treatise, and are, therefore, dismissed for the present.

Dr. Aitkin answers the question by saying: "We have no specific treatment which can cure the disease or eliminate the poison," and Dr. Hartshorne declares that "no specific remedy having been discovered, we must be governed in our tentative treatment by our idea of its nature, while concluding upon its therapeutics finally through experience. Nothing, it must be confessed, is very satisfactory as yet in the management of bad cases." Jacobi expresses himself as follows: "I know of no specifics for diphtheria, and recommend no uniform treatment for all persons and all cases."

These quotations no doubt truthfully and lucidly express the prevailing convictions of the medical profession; and yet are logical intimations of the belief that a specific may exist, and a hope that careful observation and research may reveal it. It is certainly no less probable that such may exist for this particular form of blood-poisoning than for such others as the malarial and syphilitic. Then, the continued trial of new remedies, indicating unrest and dissatisfaction with the result of every therapeutical resource hitherto applied; are eloquent and logical, even if only inferential proofs of a belief in the probable existence of some such remedy.

The result of the writer's experience and convictions is that he can truthfully reverse the negative reply to Prof. Flint's question, "Is there any known specific remedy for this disease?" and confidently intrust his affirmation to the severe scrutiny and crucial tests to which such a claim must be subjected by the medical world.

CHLORAL TREATMENT.

To set forth the claims of chloral hydrate to specific virtue in the treatment of diphtheria, is the main object of this monograph, and the sole excuse for adding another to the long list of books on this subject. Frequent references have already been made to this treatment, especially in the chapter on local treatment. A farther canvas of the claims of chloral as a constitutional remedy will necessitate more or less of repetition, for which the forbearance of the reader is solicited.

The merit of the discovery of chloral, in 1832, is accorded to Baron Liebig, and its production and composition determined by him and Dumas. The remarkable anti-septic, disinfectant, and deodorizing powers of this invaluable remedy might reasonably be inferred from the materials employed in its manufacture, viz; dry chlorine gas and absolute alcohol. "In the experience of Dr. Squibb, ninety-two pounds of alcohol required the continuous generation of chlorine gas for twenty-eight days, using about 1¼ tons of mixture of manganese binoxide and common salt, and yielded about 160 pounds of crude chloral." (National Dispensatory.)

Chloral hydrate is not, however, merely condensed and solidified chlorine gas, although it possesses many qualities in common with both it and alcohol; but is a new substance, having qualities not known to exist in either, or in both combined in any other way. In its power to allay pain and produce sleep it may be said to somewhat resemble opium. Its control of pain is less positive, and the sleep induced more like natural sleep. It seldom produces the untoward effects of opium, such as nausea, dryness of the fauces, constipation, anorexia, dysuria, headache and giddiness or malaise. On the contrary it is a valuable remedy in nearly all these states. Its efficacy is especially exhibited in exhausted and debilitated conditions; as from overtaxing the brain by prolonged mental application or emotional excitement; or the debility occasioned by acute disorders; and also in various nervous diseases caused by anæmia or exhaustion; in puerperal convulsions, mania, chorea, delirium tremens, and tetanus in advanced stages.

Its sensible effects, when taken by an adult in doses of 15 to 30 grains, are exhibited usually in from five to ten minutes, by a feeling akin to mild intoxication, accompanied almost from the first by a desire for quiet repose. The face is a little flushed, and the frequency of respiration and the pulse-rate somewhat diminished. The sleep induced is generally natural and refreshing. Its anti-pyretic effects, in cases of exalted temperature, are marked, while its sedation of cardiac excitement and irregularity is nearly as noticeable as its calmative effect upon the brain and nervous system. The stomach, too, is quieted by its operation, nausea diminished, and the toleration of food and medicine improved. These are a few of the better known constitutional effects of chloral hydrate.

Besides its topical virtues in diphtheria (see chap. XVI.) it is highly esteemed as an antiseptic dressing in surgery and in the treatment of various local and skin diseases. Few remedies of its years are so honored and esteemed by intelligent observing physicians.

Its power to prevent putrefaction and to destroy or prevent putrid emanations is well known, and has led to its employment for the preservation and deodorization of pathological specimens and bodies for dissection. Its power also to disintegrate, or in some manner to destroy, the diphtheritic false membrane during its vital connection, has been so often observed by the writer as to preclude doubt, and is as strongly affirmed by other observers. (See *local treatment.*)

Diphtheria, in the opinion of the author, *is never primary in any locality;* its local lesions are only the visible manifestations of the destructive effect upon the blood of the invisible intangible miasm traversing its channels, unbalancing its equilibrium, and destroying its vital and nutritive properties, as shown by increasing debility, with corresponding increase of the infiltration of the glandular and other tissues with plastic material that may also occasion coagulation in the cavities of the heart, with fatal results. All this infiltrated, exuded, or coagulated plastic matter, wherever it exists, is abstracted from the blood.

In suddenly fatal cases, the decomposed condition of the blood indicates so violent an action of the toxic agent that the blood was immediately so changed in its properties as to render it incapable of coagulation and of supporting life. In such cases it is obvious that no treatment can be of any avail.

What is chiefly required of a remedy in diphtheria is, then, so to act upon the blood, or the specific virus in it, as to correct its constantly evinced tendency to coagulation and loss of its fibrin. In the rapidly fatal cases noticed, its coagulating power (which is what is usually meant when we speak of its vital properties) is immediately destroyed, and restoration placed beyond the reach of medicine.

Has chloral any such power over the tendency of living blood to coagulation?

Blood within its natural channels in *health* shows no such tendency; when withdrawn and exposed to the air, and in this way deprived of its vitality, coagulation speedily ensues. If an ounce of healthy human blood, as it flows from an open vein, be caught in a wine glass or vial containing one-fourth of an ounce of a ten per-cent solution of chloral hydrate of the same temperature as the blood, and stirred sufficiently to intermix the two, no proper coagulation will afterward occur. If the vial be corked no apparent change in color or consistency occurs thereafter. In appearance it is like carmine ink, and flows from the pen as freely, making a bright red mark like fresh arterial blood.

This action of chloral upon human blood may be called specific or antiseptic, or by the votaries of the bacterian theory it might be called bactericidal, as it has been shown to be fatal to these low organisms. To whatever class it may be assigned, or whatever be the rationale of its operation, the fact is, in my mind, well established, that it exerts a similar influence upon the living blood in the body. Prof. Bartholow makes the following pertinent and suggestive remark as to the therapeutical properties of this remedy. "Besides its powers to allay the spasms (in croup) it is one of the few remedies which possess the property to check the formation of an exudation." He is here discussing the systemic treatment of croup, and hence must necessarily refer to the effects of chloral upon the blood, by virtue of which effects it limits or arrests the tendency to local exudation within the larynx. Upon this point this erudite writer speaks as one possessed of positive convictions, if not positive knowledge of the fact affirmed, namely, *it is one of the few remedies known to possess the property to check the formation of an exudation.* It checks this tendency, then, of necessity, by correcting the dyscrasia in the blood; or, in other words, counteracts or antagonizes the abnormal tendency to separation, as well as to coagulation of its fibrinous elements.

Prof. Bartholow is an acknowledged authority in therapeutics, and we cordially accept his teaching on this subject, as it confirms our own convictions long since expressed, and now confirmed by a very large experience.

In no other disease is the tendency to membranous exudation so strong and so general as in diphtheria. As before stated, it is likely to attack and complicate any abrasion of the common integument, or irritated portion of the mucous membrane; and in most cases of the disease the thickness and extent of the membrane are considered the index to the proportionate violence of the disease. The disease not being *primary* in any locality, and uniformly the result of a specific poison in the blood, rapidly destroying its integrity and life, it is apparent that the indications for treatment would not be met if limited to the indispensable resources of the kitchen, no matter how systematically administered; nor by merely tentative treatment. A remedy is needed more rapid in action than the destroying virus, and potent enough to limit its ravages or to antidote its toxic agency.

The effects of chloral in solution follow quickly its introduction into the stomach, from which it is almost instantly absorbed, and appears in the blood in its identity, and not, as formerly taught, changed into chloroform. Its specific effects upon the blood are, therefore, speedy, and no doubt are also in proportion to the amount taken up. The amount tolerated and necessary to its best effects is to be judged by the degree of somnolence induced, which should never be profound or comatose, but mild and constant, and continued only till its office is performed, generally till the disappearance of the membranous exudate.

The conservative character of the effects produced are to be judged by its effects on blood freshly drawn; and its further *specific* effects by the deductions of experience.

Up to the latter part of 1875 I treated diphtheria as others did and many still do, mainly with iron and quinine, and my losses tallied with theirs, being from 25 per cent. to 33½ per cent., which the records of mortality show to be its present rate under ordinary treatment. To say I had become disgusted by what is called the intractable nature of the disease, and its fearful fatality, is too feeble language to express my feelings. I wished most earnestly that I could be excused from ever seeing another case, and lost all confidence in the modes of treatment employed, and determined to try some other. I am still in very great doubt, as are also many others, whether there is not more harm than benefit resulting from the drugs usually employed.

The astringent preparations, of iron, for example, if taken into the blood, must increase its tendency to coagulate. Chloral preserves its fluidity, and thus limits or prevents fibrinous separation and exudation, and diminishes greatly the danger of extension of the exudate into the larynx and nares; indeed, so great is its power of preserving the fluidity of the blood, that the vessels of anatomical specimens injected with it by Dr. Keen, were found after several months to contain semi-fluid blood, instead of the dirty pasty mass usual.

Iron is apt to derange the digestion, according to Pareira, whose views are confirmed by common experience; and to create disgust and nausea, rather than to promote appetite. Chloral, instead of interfering with the digestive function, allays nausea, and thus promotes appetite.

Iron raises the arterial tension and the temperature, hence increases fever. Chloral diminishes the arterial tension and efficiently lowers the temperature in febrile states, and diminishes the force and frequency of the pulse.

Iron increases nervous irritability, while chloral allays it. Iron both constringes and irritates the mucous surfaces of the fauces, thus diminishing local secretion. Solutions of chloral, passing over the inflamed and irritated surfaces, disinfect them, and both by its local and constitutional effects favors healthy secretion.

Under ferruginous treatment, the opiates required to obtain the needful rest often materially interfere with the normal secretions; under chloral, abundant natural refreshing sleep is obtained without the vital functions being in any way interfered with, or secretion arrested; hence albuminuria is rendered less frequent.

Iron manifests no particular effect on the toxæmia, while chloral, by antagonizing the specific poison, diminishes the toxæmia and consequent prostration, and renders paralytic sequelæ less frequent.... Chloral is by many writers and practitioners regarded an unsafe remedy in debilitated states, in which we have shown it is specially beneficial, from fear of its paralyzing effects upon the heart. It is yet to be proven that pure chloral in medicinal doses is a depressant; it is more easily proven to be a conservator of nervous and muscular power by its sedation of nervous excitement, and the refreshment which results from the repose of quiet sleep, induced by its use. Its effects upon the pulse and temperature cannot come of induced debility, for the reason that no debility results from its use; which fact is apparent to the dullest perception; as it occasions no delirium, no pallor, no blueness of the skin, no muscular tremor, nor unsteady action of the heart, no sighing respiration, no clammy perspiration, nor any other symptom of resulting weakness or paralysis. On the contrary the mind is calmed; pallor diminished by equalization of the circulation; the tremors even of dipsomania calmed; the gait is steadied; the pulse is rendered soft and full; the secretions are not arrested, but promoted, and *some*, notably of the mucous and salivary glands, are increased. Quite probably chloral will repeat the history of digitalis, which but recently was thought by all writers to be only a substitute for the lancet, and to reduce the action of the heart only by weakening it; but has now become the standard tonic in affections of this organ. No increased debility of the heart or any other organ ever results from the proper medicinal use of chloral hydrate. Nine grammes (nearly 140 grains) were given without harm by Laseque to produce sleep in a patient suffering from rheumatismal meningitis, in which belladonna, quinia, and other remedies, had failed. Sleep ensued, and the patient recovered. (Trousseau.) Several hundred grains, in doses of from twenty to sixty grains, are frequently given by the best physicians, in a few hours, in diseases of great debility, as puerperal eclampsia, puerperal mania, &c., not only without harm, but with the happiest results.

Trousseau advises a first dose of 4 grammes (gr. 60) in puerperal eclampsia, to be followed by fresh doses of one gramme as soon as the action becomes feeble. Verneuil advises chloral in large doses, and to the extent of 8 to 12 grammes daily, in traumatic tetanus. Trousseau reports fourteen cases of slow tetanus, treated with one and one-half to three drachms of chloral daily, and continued from twenty-four to sixty days, with eleven cures; a better showing than can be claimed for any other treatment. In none of these cases is debility claimed or proven to be a contraindication to or result of its use. But, were the results of such extreme doses less favorable, or even fatal, they could not with any sense be claimed to prove that ordinary medicinial doses, continued for a few days, were dangerous. Atropia, strychnia, and arsenic, are given in medicinal doses with impunity and benefit for long periods, although it is certainly known that they are deadly poisons when administered in too large doses. Even gluttonous meals of wholesome food are sometimes fatal, yet nobody would be so senseless as to base upon such occurrences an argument against rational eating. No more would the evils resulting from the abuse of chloral, or from an idiosyncracy, militate against its legitimate use in disease.

The treatment of diphtheria with chloral hydrate as a chief, or I might say as a specific remedy, was first employed and advocated by the writer in 1875. Since that time he has employed it in more than five hundred cases of well defined diphtheria, with a mortality of less than two per cent. Like other well attested specifics for other diseases, the earlier in the disease the administration is commenced in any case, the better; for, as a rule, the toxæmia is rapidly progressive, and, beyond a certain limit, will overwhelm the vital powers, and defy any treatment.

Chloral is advised in all cases, (see formulæ 22, 23 and 24) in the place of the irrational iron and quinine mixtures in general use, and is given in small doses to the extent of inducing a quiet somnolent state. A moderate hypnotic effect is, in my experience, essential to the best results, as at this point, if not before, the temperature and pulse rate are reduced, and worry, headache, and nausea disappear. We know, too, by this effect, that the remedy has been absorbed into the blood in sufficient quantity to produce upon it specific effects.

Occasionally it is found best to begin treatment with a much larger dose in order to reduce the temperature and pulse, and to obtain a night of repose, as in the following case. Oct. 27th, 1881, Mrs. H., aged thirty-five years, and in ordinary health, whilst away from home on a social visit, observed in the early part of the day that swallowing caused acute pricking pain, and soon after an attending sense of fulness and soreness. The preceding night her sleep had been interrupted and unrefreshing. As the day advanced, headache and backache came on, followed, after a hearty dinner, by nausea and vomiting, with violent pains in the head, neck and throat, with sensations of violent general sickness, and severe chills alternating with brief paroxysms of high fever. She was conveyed home late in the afternoon. At 8 P. M. she was visited and the preceding history of the attack elicited. The pulse was now 115 and bounding; temperature 104½°; eyes suffused; skin hot; tongue moderately coated and dry, and purplish red in the centre; nostrils stuffed and violently congested; deglutition difficult and painful; tonsils, uvula and velum swollen, with patches of false membrane upon both tonsils; submaxillary and cervical glands swollen and tender; bowels constipated. Ordered twenty grains each of soda bicarb.

and calomel, to be taken immediately, and followed at 9 o'clock by ℞ Chloral hyd. ʒ ss, tr. opii deod. gtt. xv, in half an ounce of well sweetened water. The throat to be covered with a light linseed poultice, and enveloped in soft flannel, and the patient to be allowed to rest for the night without further medication. 28th, A. M.—Patient had quiet sleep during the night, and this morning two fecal dejections. Pulse 84, temperature 99°, tongue moist; some increase in exudation, but less faucial and nasal congestion; glands of neck still swollen, but less tender. Ordered formula No. 22, which with a few slight variations was kept up till November 2d, when the patient was discharged — cured. After the night of the 27th, only dry soft flannels were applied externally.

To a child of five years suffering from a moderately severe attack of diphtheria, about thirty-two grains of chloral hydrate in twenty-four hours is the usual quantity administered; in combination with an equal amount of chlorate of potash, (Form. No. 23) in syrup and water, and administered in drachm doses hourly, except during refreshing sleep. The quantity should be increased or diminished in proportion to the age of the patient, and according to the exigencies of the case; and if marked somnolence be produced, the frequency of administration may be somewhat diminished. The administration is uniformly commenced on the first visit, and continued till all exudation has disappeared, and longer, in diminished quantity, if the toxæmia or local manifestations demand it.

Should the irritability of the stomach seem to preclude the present administration of chloral, it will generally be found to be controlled by the laxative before mentioned, and if necessary, recourse may be had to such other means as are generally employed to allay nausea.

Should the febrile manifestations be very marked, a few doses of aconite or veratrum may be administered, but in most cases the chloral is the only febrifuge required. If, on the contrary, malignant or typhoid symptoms are manifested, the administration of pure rye or bourbon whisky, or pure brandy, in milk punch or egg-nog, or other eligible forms, is indicated, and if well borne, continued in increasing quantities, up to the limit of toleration. While administering alcoholics, the chloral mixture should generally be continued in alternation.

Experience has shown that the excessive use of alcohol is seldom required in connection with the chloral treatment ; if, however, it be indicated, as above, its use is emphatically endorsed.

If headache or pharyngeal or other pain be complained of, these generally subside within a few hours after the commencement of the chloral treatment.

The mouth and faucial and pharyngeal surfaces are effectually disinfected by each dose, and as the local action of the remedy is also desirable, no drink should be permitted for several minutes afterward. In most cases no other local treatment is required. For other local treatment see chapter XVI.

The patient should be allowed abundance of agreeable, refreshing, and nutritious drinks, as cold water, milk, lemonade, barley or rice water, toast coffee, beef tea, or milk and raw egg. For further directions with regard to nourishment, see chapter XIV.

CHAPTER XVIII.

NASAL DIPHTHERIA.

Nasal diphtheria is much more frequent in some epidemics than in others, and is so designated solely on account of the implication of the nasal passages, either as the primary seat of the local affection, or as the consequence of its extension to the nares from the pharynx.

The nares are, however, but seldom at the first invaded by the diphtheritic inflammation, or the original seat of the membranous exudation. The affection is generally secondary, the result of the extension of like processes from the pharynx. The disease, or, rather, the complication, is usually at first shown by a yellowish or brownish ichorous discharge from the nostrils. The mucous membrane is congested and reddened, and the passages soon become occluded by swelling and the membranous deposits, which, at times extend continuously from the posterior nasal orifices to the anterior, occasioning great embarrassment of respiration.

In some cases we observe, however, only scattered deposits on the mucous surfaces of the septum or turbinated bones.

The general treatment of this form of diphtheria is in all respects the same as in other forms of the disease. The nasal passages should be frequently cleansed and disinfected in order to prevent putrefaction and secondary blood poisoning by absorption of septic matter thus formed.

In my observation, paralysis of the pharyngeal muscles is, doubtless as a result of neglect to cleanse these surfaces, more frequent in nasal, than in other forms of the disease. It is, therefore, of the first importance to keep these passages as thoroughly cleansed and disinfected as possible. This is to be accomplished by the abundant injection of weak pure soap-suds two or three times daily, followed by weak solutions of chloral hydrate (three to fifteen per-cent), carbolic acid, lactic acid, permanganate of potash, alum, or tannin. Preference is given to the chloral solution.

The nasal as well as the pharyngeal surfaces may be effectually treated by inhaling the vapor exhaled by slacking lumps of lime in a three per-cent solution of chloral hydrate, in a wide mouthed bottle. This should be repeated every three or four hours. The vapor may be rendered aromatic by adding a small amount of any agreeable perfume or essential oil to the liquid used.

Should epistaxis occur, and it is not very unusual, it may be controlled by injections of Monsell's solution diluted with four to six parts of water, or by the use of a snuff composed of persulphate of iron one part, and starch three parts.

CHAPTER XIX.

LARYNGEAL DIPHTHERIA.

Laryngeal diphtheria, denominated also diphtheritic croup, has been fully described in chapter X, to which the reader is referred.

Its differential diagnosis from that other form usually denominated pseudo-membraneous laryngitis, or true croup, is not generally difficult, and yet may at times be nearly or quite impossible. To, the general practitioner the conflicting arguments for and against their identity, are of little value or interest, only as they may possibly influence his treatment of the case. Fortunately he is rarely placed under circumstances of so equivocal a nature as to occasion serious doubt, and should such conditions occur, he can derive little aid from controversial writings. The following observations will materially aid in properly classifying any given case.

A case is *diphtheria*, 1st. When it is the result of extension of diphtheritic inflammation and exudation from the pharynx or nares.

2nd. When it can be clearly traced to diphtheritic infection, and is ushered in or preceded by constitutional pyrexial symptoms such as characterize attacks of diphtheria.

3rd. If the case occurs during the epidemic prevalence of diphtheria, and is attended with swelling of the tonsils, the parotids, submaxillaries, or the cervical lymphatic glands, any or all of them.

On the other hand, the case is *croup*, 1st. If it be without constitutional symptoms other than those attributable to laryngeal inflammation and exudation, as partial aphonia, croupy cough, slight fever, and embarrassed respiration.

2nd. In the absence of diphtheritic exposure, if the disease be sthenic in its symptoms, and primarily locally limited to the larynx.

The *treatment* of this class of cases is not shown to have been very satisfactory hitherto, as by far the largest part of those attacked have died. The *prevention* of laryngeal complications, by early and efficient constitutional and local treatment is, no doubt, much more effective than any means that can be employed after the larynx is invaded. But suppose laryngeal symptoms to arise in any case, the earlier they are detected, the more hopeful may we be of favorable results.

It behooves the physician therefore to keep a careful watch in every case of diphtheria, in order to detect the approach of laryngeal complication, which, as shown in chapter X, is ordinarily heralded by greater or less vocal impairment; as, slight hoarseness of the voice, and croupy cough; or by slightly stridulous breathing. All these symptoms are magnified by increase of the laryngeal tumefaction and exudation, till by occlusion of the larynx the act of efficient respiration is rendered impossible.

The general medication in such cases need not be materially modified except to be pressed with a vigor commensurate with the danger. The same is also true of the external local treatment, which at most need only be supplemented by efficient fomentation by means of flannels wrung out of hot weak solutions of chloral, changed every fifteen minutes. Have two sets of flannels, in order that the throat may not be exposed in changing. Light flaxseed poultices are likewise to be commended.

By far the most important and promising item in the treatment at this period consists of the administration by inhalation of fluids vaporized by slacking lime, or atomized by an atomizer. For this purpose Mackenzie advises the use of lactic acid (gr. xx in ℥ i), to be used at least every hour, and continued for five minutes. Prof. Smith gives preference to limewater for this purpose, and advises its constant use.

Having myself had no experience with the lactic acid spray, it is sufficient to say that it is strongly advocated by so high an authority as Dr. Mackenzie. I have had experience with limewater spray, but in my hands it has proven less useful than a three per cent. solution of chloral hydrate, and I have found its use troublesome on account of incrustations forming upon the parts of the atomizer, so as, sometimes at a critical period, to prevent its working.

Believing, therefore, that chloral is a better disinfectant and destroyer of the diphtheritic exudate than is limewater, as well as more convenient in practice, I advise its use for ten or fifteen minutes hourly. The vapor of lime and chloral, as advised (see ℞ 17) is specially recommended.

There must be no relaxation in the administration of nutrients and stimulants, which, if necessary, may be given in enemata.

These measures must be reasonably persisted in till the stridor and hoarseness are relieved, and the false membrane destroyed or expelled.

If this treatment is not successful, there now arises one of the most difficult questions the physician is ever called upon to decide; namely, the propriety of *tracheotomy*. Out of the greatest perils there is no doubt a few have, by this means been rescued; and from perils apparently equally great, a larger proportion have recovered by the persevering use of means less violent. I know of no satisfactory statistical or other basis for the clear solution of this grave problem. It must therefore be largely a matter of individual judgment, aided, if possible, by the best available counsel.

Time, to confer and debate the problem at the bedside, is in every case exceedingly brief, from the very nature of the case. It may be that even a few moments of apparently unavoidable delay or doubt will prove fatal;—instantaneous decision and corresponding action are all that remain. In the writer's judgment the propriety of the operation in any case of general infection is exceedingly doubtful, and unfortunately, such systemic infection exists in every case of undoubted diphtheritic pseudo-membranous laryngitis.

CHAPTER XX.

TREATMENT OF DIPHTHERITIC PARALYSIS.

Diphtheritic paralysis, the only frequent sequel of this disease, is not ordinarily attended with great danger to life. Its mode and period of development, and its attending phenomena are described in chapter X, which see.

Although rarely fatal, and tending to spontaneous recovery, it by no means follows that medical treatment is unimportant in these cases.

When the paralysis is slight, and limited to the pharynx and soft palate, as is most frequently the case, little is needed to be done, save careful nursing, with the tonics appropriate to this stage of convalescence; and here, if at all, in diphtheria, is an appropriate sphere for *iron*. Quinine and cod-liver oil are also needed.

In the graver cases of muscular paralysis, there is in addition, a need to call to their aid other therapeutical agents. If there be marked loss of power of the pharynx and œsophagus or epiglottis, rendering swallowing difficult or impossible in the former, and dangerous in the latter; the administration of nourishment per rectum may become a necessity. For this purpose milk with raw egg beaten in it, or strong beef-tea, with milk and brandy, are to be used, with the addition of a few drops of tincture of opium to prevent immediate expulsion. These may also be made the vehicles for the administration of remedies, as strychnia, iron, and quinine, which are now needed. The feeding and administration of medicines may also be effected by means of the stomach tube. One or both of these modes may be a necessity to prevent death from starvation.

If the paralysis prove severe or obstinate, we should, regardless of its seat, resort, in addition, to electricity, friction with the flesh brush or the naked hands, and local stimulants, as tincture of capsicum, or ammonia.

The writer has been well pleased with the effects of the magneto-electric current, though the other electric currents in a mild form are recommended.

CHAPTER XXI.

MEDICAL PROPHYLAXIS.

If the views entertained by me of the chloral treatment of diphtheria are well founded, as I believe them to be, and if, as I also believe, its effects are produced primarily on the blood, and through its medium only, the following sequence is, to say the least, logical.

The effects of chloral being antagonistic to the systemic poison, or in other words, antidotal thereto in the more *advanced* stages, it is likely to be equally so during the stage of incubation, and therefore an efficient theurapeutical prophylactic.

That it is such I have often demonstrated in practice, to my perfect satisfaction. It manifests a remarkable power over the diphtheritic poison in every stage of its development.

When given to persons exposed, in the doses heretofore advised, three or four times in twenty-four hours, I have almost uniformly observed that if they contracted the disease at all, its form was mild. In most instances its protective influence has seemed positive, and its use for the purpose, though new to most practitioners, is earnestly recommended. A little experience in its use will dispel incredulity, and prove the value of this new departure.

CROUP.

CHAPTER I.

In its ætiology croup has little in common with diphtheria. Croup generally has its origin in colds, and rarely occurs except in Winter and Spring, during the prevalence of inclement weather, and is neither contagious nor epidemic; whereas diphtheria originates from a subtile blood poison, prevails at all seasons of the year, and is both contagious and epidemic. Pathologically their relationship consists in the development in both of a similar exudation; in the former always within the larynx, in the latter almost universally upon the pharyngeal surfaces, from which its extension into the nares and larynx, as well as its development upon any abraded surface of the body, is not rare. We regard both as forms of toxæmia, for the reason that common acute inflammation never, or very rarely, leads to a membranous exudation.

Just what the antecedent or coexistent cause of the blood poison of croup may be, aside from the catarrh by which it is ordinarily introduced and seemingly induced, is not known; we are only familiar with the course and phenomena of the disease. These differ as widely from diphtheria as they do from fibrinous bronchitis. All three of these diseases are characterized by an identical membranous exudation, but are not therefore even *suspected* of being one disease. There is no better reason for suspecting the identity of croup and diphtheria than there is for reckoning all three to be one, and simplifying the nomenclature by calling all diphtheria.

Indeed, Sir J. R. Cormack has suggested that plastic bronchitis may be a variety of diphtheria, and numerous other writers of great distinction treat croup and tracheal diphtheria as identical. Nevertheless the very wide clinical differences observed by all, are sufficient to distinguish them as separate diseases, having the one characteristic, a lamellated membranous exudation, in common.

Their histories are as distinct as their clinical differences, and both alike disprove their identity. . . . The common *membrane*, it must be admitted, is suggestive of a similar effect being produced upon the blood by the causes which call into existence these separate affections. Although common forms of inflammation never produce such an exudation, it does not follow that the different causes of these diverse maladies may not, to some extent, similarly affect the blood, and be amenable to like treatment.

Fibrinous exudations prove either such an affection of the blood as predisposes to coagulation, or a peculiar form of local inflammation, producing topically, in croup and plastic bronchitis, a condition that in diphtheria has been shown to be systemic. Either may be admitted, or both, without materially influencing the treatment, for the reason that, in the presence of so great danger, no topical or general treatment, known to have a favorable influence is likely to be disregarded, whether it exactly fits our philosophy or not.

The disease now under consideration is given a variety of appellations, as pseudo-membranous laryngitis, croupous or plastic laryngitis, cynanche trachealis, membranous croup, true croup, etc., to distinguish it from other varieties of laryngeal inflammation. The term *croup*, which was first employed by Sir Francis Home, has long been applied to this malady, and is expressive of its earliest symptoms, hoarseness and stridor. Its derivation is uncertain and unimportant, while its true meaning is expressive and significant. "Croupy cough" and "croupy breathing" are popular expressions that are never misunderstood nor disregarded by medical men, and very seldom by the laity. They inspire the popular and the professional mind alike with a well-grounded sense of impending suffering and imminent peril.

The disease is essentially a plastic laryngitis, dependent largely for its origin upon exposure in inclement weather, and in some degree perhaps upon specific causes, and also upon peculiar personal or family susceptibility; and not upon any peculiar contagium.

Croup is essentially a disease of childhood, between the ages of two and seven years, but occasionally occurs outside of these limits. It prevails mostly during Winter and Spring and is only exceptionally observed during Summer and Autumn. Its occurrence as a consequence of or in immediate connection with common acute catarrh, so masks its stealthy invasion that its serious character is often unsuspected: the patient is thought only to have "caught a cold."

Early symptoms and diagnosis. First Stage. Pseudo-membranous laryngitis in its early stages is with difficulty diagnosed from simple or ordinary catarrhal inflammation. Its symptoms are such as depend solely upon laryngeal obstruction. This obstruction is at first, as in all the other forms of laryngitis, due to sub-mucous infiltration, or inflammatory swelling. An inflammatory stage, as in diphtheria, precedes the exudation or the period of membranous formation. Then as croup is, unlike diphtheria, neither epidemic nor contagious, no reliable diagnosis can be based upon its epidemic prevalence, or upon exposure depending upon the presence of others affected by the disease. The slight roughness or hoarseness of the voice and clanging or barking cough, as before intimated, are no *more*, often *less*, marked in the croupous than in simple catarrhal or accute forms of laryngeal inflammation. Auscultation shows that both the inspiratory and expiratory sounds are a little prolonged, and that the vesicular murmur is more or less marked by laryngeal stridor. The supraclavicular, intercostal, and præcordial spaces are somewhat depressed during inspiration, the depression being in proportion to the obstruction. Neither rigor, prodromic symptoms, nor peculiar form of fever, indicates the true nature of the attack, any more than do the character of the voice and cough. No characteristic expectoration or faucial inflammation or adenitis are so manifest as to enable the anxious practitioner to surely solve the problem of diagnosis. Is its solution then impossible? It is only just to confess that, in the early stages, it sometimes *is* impossible. With physicians of experience and culture, and quick perception of cases, a diagnosis is often like an intuition or a superadded sense, and is no more communicable to a novice by words than are the most difficult problems of geometry. This superadded sense or ready interpretation of the physiognomy of disease is a large element of medical proficiency, and either *is*, or *underlies*, skill. What, then, we inquire, are the best communicable instructions to aid junior members of the profession to fix upon a diagnosis in the early stages or first period of croup, as a basis for the treatment of this most deadly foe of children?

1*st*. Remember that the characteristic symptoms are generally (not always, it must be confessed,) more slowly developed than in the simple inflammatory or spasmodic forms of laryngeal obstruction. The cough and stridor are less marked and more insidious and prolonged in this early period, than in the usually harmless spasm of the glottis, whether accompanied or not by some degree of inflammation.

2*d*. Fever is induced alike in the simple and the croupous forms of laryngitis, and hence is not pathognomonic. It may be said often to appear earlier, and at first with greater violence, in the simple form of laryngitis than the croup.

3*d*. The differential diagnosis, to be reliable, must depend upon the discovery of the pseudo-membrane. If we are able to make visible the interior of the larynx by means of the laryngoscope, the presence or absence of this formation will remove all doubt. This method is not always practicable, and with timid children, suffering often as much from fright as from dyspnœa, is very generally impossible. "If," says Prof. Flint, "the demonstration by this method fails, the presence of a false membrane is to be inferred, *first*, from the degree of obstruction being greater than in simple acute laryngitis, provided the patient be a child; and *second*, from the presence of an exudation in the pharynx, which is determinable by inspection of the throat. The latter is by far the more reliable. Clinical observations go to show that, in the great majority of cases, an exudation visible in the pharynx accompanies pseudo-membranous laryngitis exclusive of the occurrence of the latter as a complication of diphtheria. There are, however, some cases in which this evidence is wanting. In these cases a positive diagnosis cannot be made independently of the laryngoscope, until portions of the false membrane have been expelled by coughing. In all cases the expectoration should be carefully examined with reference to this point. The portions of false membrane expectorated are sometimes rolled together with the mucus into a mass which must be carefully unrolled in water, in order to determine its membranous character. This evidence of the affection is rarely obtained if the patient be under five years of age on account of the expectoration being swallowed."

These remarks by this great teacher serve more to show the difficult character of the problem under consideration than to aid in its solution; although it must be acknowledged they are as truthful as they are characteristically frank and instructive.

Let us call to our aid a clinical example. E. S., aged five years, contracted a cold from exposure Nov. 12th, 1880. Family are constitutionally predisposed to croup, two children having previously died of the disease. Parents and living children constitutionally sound except the predisposition above mentioned, which has also been manifested by several violent attacks of diphtheria. Sanitary surroundings and other circumstances reasonably good. When called on the 15th the patient appeared but slightly ill; for three days had had a cold and been moderately but increasingly hoarse, with croupy cough keeping pace with the hoarseness, appetite impaired, fever so slight that of itself it would not attract attention; had a rather restless night, respiration slightly stridulous and distinctly audible. No view of the interior of the larynx could be obtained; epiglottis and adjacent parts congested and coated partly with what appeared to be condensed mucus, no dysphagia nor glandular swelling. Diagnosis membranous laryngitis.

If in this stage any doubt may have existed, the subsequent history showed unequivocally the correctness of the diagnosis.

At this early period of the disease, the symptoms as epitomized by Bartholow, are as follows. The attack of the croup usually but not invariably begins as an acute catarrh of the larynx; there is a feeling of heat and irritation in the organ, and the voice is a little husky; there is cough with something of stridor about it; and fever, restlessness, thirst, anorexia, and disturbed sleep accompany the evidences of laryngeal mischief. When the fauces are inspected, more or less redness, sometimes dusky redness, will be observed, and also small patches of a thin pellicular exudation of a grayish-yellow color, studded over the palate, tonsils and pharynx. These patches presently coalesce and then form a dense membrane several lines in thickness (?), of a yellowish gray or ash color. As huskiness of voice was one of the initial symptoms, the same patches of pellicular exudation are forming in the larynx.

Evening exacerbations, followed, as morning approaches, by remissions, are, during this period, extremely common, but are at most only suggestive, and not to be considered diagnostic. Says Prof. Mackenzie: "In children it is sometimes very difficult to distinguish catarrhal laryngitis of a severe form from croup. Indeed, in the early stages it is often impossible to differentiate the two maladies."

On the other hand J. Lewis Smith (Diseases of Children) writes: "The diagnosis of true croup is ordinarily easy. It might be mistaken for spasmodic laryngitis, but more frequently spasmodic laryngitis is mistaken for it. The differences which will aid in the differential diagnosis are the following: Commencement abrupt and at night in the one, gradual in the other; presence in one and absence in the other of pseudo-membrane upon the surface of the fauces; fragments of membrane in the sputum in one; character of the cough, course of the disease growing gradually in one, in the other, with few exceptions, rapidly improving." Trousseau speaks of the liability to error of diagnosis in these cases in which spasmodic laryngitis is associated with pseudo-membranous pharyngitis. "Few physicians hesitate to designate as true croup these cases in which there is a croupal cough in connection with false membrane upon the surface of the fauces, and yet the laryngitis, under such circumstances, may be merely spasmodic. This coexistence of pseudo-membranous pharyngeal and of spasmodic laryngeal inflammation is, however, probably rare, but its occasional occurrence should be borne in mind."

Just how Prof. Smith has rendered the "diagnosis of true croup easy" in the preceding quotation is not easy to see, as he has failed entirely to notice the difficulty of differentiating the disease from catarrhal laryngitis, which Mackenzie truthfully declares "is often impossible." Much of the apparent clearing up of the diagnosis of true croup comes from its being considered by Trousseau, Mackenzie, Bartholow, and others as identical with diphtheria; hence the frequent reference to the discovery of membranous deposits on the pharynx as diagnostic of *croup:* it is, however, more commonly pathognomonic of diphtheritic infection, and its appearance is exceptional and rare in uncomplicated true croup. A certain diagnosis at an early period of the disease is frequently simply *impossible.*

Later Symptoms. As the disease advances the skin becomes hot and dry, the face flushed, eyes suffused, breathing more hurried and stridulous, cough more hoarse and frequent until it becomes toneless, a mere spasmodic expiration; the labored and hoarse phonation is nearly, and finally entirely extinguished. The patient, already suffering from asphyxia, becomes alternately dull, and fretful and passionate. Then occurs a lull, respiration somehow is a little easier, probably in consequence of relaxtion of the laryngeal structures, the effect of the increasing carbonic acid toxæmia, and the patient not only breathes better, but from better oxygenation of the blood becomes temporarily less stupid, and for a very brief period seems quite himself again. Very soon, however, as the irritability of the laryngeal structures is revived, spasmodic stricture is again added to the organic obstructions, the dyspnœa returns with increasing violence; the lips and nails become blue, every respiratory muscle seems to exert its utmost power to obtain the required air, inspiration is prolonged and stridulous, the intercostal spaces are depressed; the veins of the face and neck become prominent, and a profuse perspiration bursts from every pore. Expiration, though obstructed and often prolonged in proportion to the amount of air exhaled, is less painful, because not accomplished in so great a measure by the direct labor of the exhausted respiratory muscles.

The effects of the intense labor, and the accumulated carbon in the blood, soon again produce exhaustion and insensibility, and the patient again falls asleep. A brief period of restless repose and labored breathing is soon succeeded by another paroxysm even more violent than the preceding. The cough does not increase in violence as the disease progresses on account of the muscular debility, and is rarely of sufficient force to raise the mucus from the air passages, or to detach and expel the loosening portions of false membrane. The paroxysms of coughing not only do not afford relief, but on the contrary, by lifting the thick mucus or detached portions of membrane to the rim of the glottis, add to the existing obstruction, occasioning increased spasm, and may thus precipitate a fatal termination of the case. The voice during this period is usually extinguished, or so great is the effort necessary to speak, or so painful, that only a feeble whisper or sign can be elicited.

The appetite for food is entirely lost, the thirst incessant, and deglutition not generally difficult. The tongue is heavily coated with a thick white fur except the tip and edges, which are often intensely red. The fauces are red, or ash colored, and occasionally show traces of membranous exudation, but afford no index to the violence of the disease.

During the *third stage*, which now supervenes, the exacerbations grow less violent as the natural forces decline, and the intermissions fail to recur, while the respiratory effort is constantly taxing to the utmost the waning vital and muscular force. The cough grows more feeble or ceases entirely; the breathing apparently less laborious is feeble and sibilant.

The head is forced backward as in opisthotonos, the larynx depressed and alternately moving up and down in aid of the respiratory efforts, which with the co-operation of the abdominal muscles causes the chest to heave violently to increase its capacity, and force the entrance of air. The countenance grows livid and anxious, the eyes dull and pale, the skin dry or clammy and the extremities cold. The pulse becomes very feeble and rapid, the respirations irregular or intermittent: the patient throws himself about upon the couch, often clutching the throat in frantic fruitless efforts to remove the obstacle to breathing. The agony increases, the countenance gradually relaxes, and either increasing dyspnœa, coma, or convulsions, hasten the tragic scene to a close in death.

Death may occur at almost any period of the disease. Fatal cases rarely run a longer period than two weeks, or a shorter than two days. In the earlier periods sudden death is often, no doubt, the result of spasmodic closure of the glottis. Later it may result from the great extent and thickness of the membrane, or from detached portions lodging in the chink of the glottis. Still another cause of death may be found in the bronchial obstruction, caused by mucus and pus, which the feeble patient has been unable to expectorate; and yet another cause of death may be the imperfect aeration of the blood from imperfect respiration, and the consequent gradual accumulation therein of carbonic acid.

Pathology. The post-mortem appearances are in accord with the disease phenomena heretofore delineated. As death rarely occurs during the first period, few opportunities are afforded of determining the anatomical characters which then exist, but as the hoarseness and croupy cough are primarily due to inflammatory congestion and tumefaction, during the first period, only the evidences of such action are known to exist. These consist of intense injection of the larynx, either uniform or in patches, swelling, and a scanty secretion of tenacious mucus, or elementary pseudo-membrane. In its later stages, after the hyperæmia has attained its maximum intensity, the disease is characterized by the appearance upon the inflamed surface of a grayish-white semi-transparent pellicle or rudimentary false membrane, which rapidly increases in thickness, and which presents much the same physical and chemical properties as the pseudo-membrane formed in well marked cases of diphtheria. It is not of uniform density, and is found more firmly adherent at some points than at others; often it is found loose, or being only partially detached hangs in shreds or fringes. Its thickness varies from a mere pellicle to several lines. Its location is chiefly in the interior of the larynx, coating the vocal cords, the ventricles, and lower surface of the epiglottis. It is occasionally visible upon the pharyngeal surfaces, but probably less frequently than is often estimated.

The formation of the pseudo-membrane in the trachea is also common, and may extend downward to the minutest bronchi, so completely obstructing the passage of air as to have induced emphysema or atelectasis. According to Guersent, in 120 cases, the false membrane was limited to the larynx and trachea in 78, and in 42 extended also into the bronchial tubes. It is seldom so abundant in the larynx as to completely close it against the entrance of air, but on the contrary, necropsy often reveals there merely a transparent pellicle. The dyspnœa which during the first period was due solely to inflammatory tumefaction, was subsequently, in such cases, probably due to spasm of the glottis, excited by the presence of the pseudo-membrane, just as any foreign particle causes such spasm in health; for it should be borne continually in mind that the most violent paroxysms of dyspnœa, are in nearly all cases, largely due to spasm.

The *pseudo-membrane*, then, surrounded generally with epithelial debris and mucus and pus, is the peculiar characteristic of croup, as seen by the anatomist, and in the absence of this, no pathologist could venture to pronounce a case pseudo-membranous laryngitis.

Treatment. When we consider the great danger from the rapidly increasing obstruction to respiration in this disease, by the increasing congestion of the larynx and the deposit of plastic matter upon its walls, in connection with the natural narrowness and sensitiveness of the chink of the glottis in young children, in whom slight turgessence of its mucous membrane is often sufficient to cause stridulous breathing and alarming spasmodic closure, the importance of early treatment can hardly be exaggerated.

Indications. The arrest of inflammatory congestion, limiting or preventing the adventitious deposit, or if already formed effecting its disintegration or expulsion and the prevention of spasm are the chief therapeutical indications. While pursuing these objects, the necessity for properly supporting the patient's strength so that he may be able to withstand the progress of the disease, must of course be borne in mind, and is to be effected by suitable nutrition, and avoidance of such measures of treatment as tend to induce undue depression.

Of remedial measures having the sanction of most authors we first notice *emetics*. Their effects are, *1st:* To diminish the local congestion by occasioning copious secretion and expulsion of mucus. *2nd:* To detach the pseudo-membrane by increasing the secretion beneath it, and softening it, and by the expulsive efforts occasioned, to effect if possible its dislodgment and ejection with the matter vomited. Emetics are, therefore, generally considered the proper initial of rational treatment. As it is manifestly important to consider the strength of the patient, that he may be able to bear up against the ravages of the disease, and be able in the succeeding periods thereof, by vigorous cough and repeated administrations of the remedy if needful, to effect the object in view; it is essential to select such emetics as occasion the last prostration. Their repetition, to vigorous patients, as often as three to five times in twenty-four hours, it is thought, is often beneficial. *Antimonials*, which were formerly much in vogue, are therefore manifestly improper, and must be rejected. *Ipecacuanha* in substance, or in the form of sirup or wine, although less depressing, is yet objectionable unless with robust subjects, because of the continued nausea and resulting debility. *Sulphate of aluminum* in doses of a teaspoonful suspended in sirup or honey, given every ten or fifteen minutes till free emesis is produced, is highly commended by Prof. Meigs of Philadelphia and others, and is one of the best of this class of remedies; the largeness of the dose is the only objection to its use. *Sulphate of copper* is another of the most prompt and least objectionable of emetics in croup. It is conveniently administered powdered with an equal weight of ipecac. and suspended in sirup so that each drachm may contain four or five grains of the mixture, and is given in teaspoonful doses every five minutes till it operates. It has been administered as often as every two to four hours with apparently good results. So frequent administration is not generally to be advised. The *yellow sulphate of mercury* in two or three grain doses, to a child of two years, is highly praised by Dr. Hubbard, Prof. Fordyce Barker, Prof. J. L. Smith, and others. Dr. Barker gives the remedy without delay, and claims not to have lost a patient thus treated for several years. The dose should be repeated in ten or fifteen minutes if the first dose does not produce emesis. Its employment is sanctioned by the very best authors, and is commended by the writer, although partial to sulphate of copper.

If there be any degree of constipation, mild *cathartics* should be early administered.

After emesis, resort must be had to those remedies known to prevent or diminish plastic exudations, acting through the blood; also to the topical use of such as tend to remove such exudate by effecting its separation or solution. The chief remedies of this class are mercury, chlorate of potassa, chloride of ammonium, quinia, bromide of ammonium and chloral hydrate.

Mercury. This remedy, which is usually administered in the form of calomel, has been highly recommended by nearly all reputable authors of the past century. "Dr. Samuel Bard states that Dr. Douglas of Boston, who published in the year 1736 an account of the angina suffocativa, was the first to recommend the employment of mercury in croup. Bard says that he was induced to try mercurials after reading Dr. Douglas's little essay, and adds, 'The more freely I have used them, the better effects I have seen from them.' To patients three or four years old he gave thirty or forty grains in five or six days, 'not only without any ill effects, but to the manifest advantage of my patient; relieving the difficulty of breathing, and promoting the casting off of the slough beyond any other medicine.' He advises the first dose or two combined with opium, and considers mercury the basis of cure in croup." (Meigs.)

We certainly know that calomel has the effect of increasing and attenuating the expectoration, but whether it also increases the secretion within the larynx and beneath the pseudo-membrane and thus assists in its detachment, is not so easily demonstrated nor generally conceded. But this remedy has also an ancient and honorable reputation as an anti-phlogistic and alterative. On account of the former property it has been, and still is to a considerable extent, reputed to be the great antagonist to inflammation; hence it has generally been advised to continue its administration till the inflammation subsides, or the mouth becomes considerably affected.

As an *alterative* its effects are produced through the medium of the circulation. By its effects upon the blood or the disease elements, it is well known in some maladies, as syphilis, to have the power so to modify it as to effect a cure.

This power of producing an alterative effect upon the blood has been invoked in the treatment of croup. Its reputed efficacy in so modifying the blood as to diminish or prevent membranous exudation, has been sustained by the ablest writers. Prof. West, of St. Bartholomew's Hospital, London, wrote, "Calomel seems to have a twofold utility; it counteracts the tendency to the formation of false membrane in the air passages, and prevents or subdues that inflammation of the lungs which is so frequent and so fatal a complication of this disease." Says Coley, of London, "One or two grains of chloride of mercury must be given immediately, and repeated every hour, until the inflammation has subsided, or the mouth has become sensibly affected." Prof. Meigs says, "It (calomel) ought to be given early in order to produce upon the blood its defibrinizing effect, and thus prevent, or at least limit, the extension of the deposit." Such evidence of the utility of mercury in croup, from eminent authors, might be made to embrace almost the entire list of medical writers up to a very recent date. If to the mass of writers, we add the oral testimony of a great multitude of living eminent practitioners, a strong case is certainly made in favor of the use of mercury in this disease, and it is not too much to concede the propriety of its employment.

The approved mode of administering this potent remedy may be thus epitomized. To a child one or two years of age give from gr. ss to gr. i, either alone or combined with enough pulv.Dov. to prevent its cathartic effect. At the age of five or six years the usual dose is gr. i to gr. ij. These doses are usually repeated at intervals of two hours, and in violent cases are given hourly. Prof. Meigs affirms that of nine cases so treated by himself, six recovered; while of seven cases treated without mercury, five died; showing a balance in favor of mercurial treatment of 50 per cent. in the proportion of recoveries. It should be borne in mind that with mercury the other approved adjuncts, as emetics, moist air, &c., were conjoined.

Notwithstanding the affirmed utility and high repute so long enjoyed, of mercurial medication in croup, the title to its venerable reputation is at the present time greatly questioned. Prof. Mackenzie omits even its mention among the reputable remedies, whilst by some other recent writers it is noticed only to distrust, or to condemn. Neither the theory upon which the practice is based nor the practice itself is any longer regarded as invulnerable. It must be confessed that the finest *theories* of medical scientists are at the mercy of clinical *facts.* Let it be proven as stated by Meigs and others that fifty per cent. more cures are obtained by this treatment than by any other, and we shall soon see that an improved version of science will furnish an improved theory. If on the contrary, careful observation shall prove the superiority of more recent modes and remedies, no reverence for antiquity, nor list of worshipping admirers, can save this venerable giant from humiliation.

Chlorate of potash is very generally prescribed in some way in pseudo-membranous laryngitis, although both its modus operandi and the benefits resulting from its use, are questions still far from being satisfactorily settled. It was first proposed as a remedy in croup by Chaussier in 1819, but soon fell into complete disuse. It was revived again by Blache, and has ever since been used, in connection with other remedies, with more or less belief in its beneficial effects. It is regarded by Trousseau as "having a general influence over the system opposing the reproduction of plastic exudations," and he adds, "Nothing forbids the use of this remedy in so dreadful a disease as croup, without, however, placing exaggerated confidence in its virtues, and especially without using it to the exclusion of other treatment of proved (though perhaps limited) efficacy."

Its excessive use is thought to induce inflammation of the kidneys with albuminaria. Its possible dangers, therefore, and equivocal benefits in croup, should guard against its too liberal administration.

Ammonium Chloride, administered internally, has long enjoyed the reputation of having a specific tendency to the mucous membrane of the air passages, improving its tone and favorably modifying its secretion. "The idea which has appeared chiefly to direct its use in medicine is, that it tends to render all the secretions freer and more abundant, while it at the same time lessens the plasticity of the blood, in other words, that its operation is, in some respects, identical with that of mercury," for which it has been by many physicians extensively substituted in practice. Notwithstanding the suggestiveness of its reputed physiological action, it has but recently assumed an important rank in the therapeutics of croup, and in this disease is now used to a considerable extent both in private and hospital practice. Prof. J. Lewis

Smith writes of its use in Bellevue Hospital, as follows (Diseases of Children, p. 511): "Calomel has been much used in times gone by for its supposed antiplastic action, and more recently muriate of ammonia and chlorate of potassa as in the following formula.

℞	Potas. chlorat.	ʒ i.	
	Ammon. muriat.	℈ ss.	
	Syr. simplic.	℥ ss.	
	Aquæ	℥ ij.	*Misce.*

Give one teaspoonful every half hour or hourly.

"Since the discontinuance of the calomel treatment, this mixture has been largely used in New York, but is now being superseded by the atomizer, or it is being employed along with the atomizer."

Quinia and *bromide of ammonium* are accounted most valuable remedies in croup, especially by Bartholow. Quinia in full doses of gr. iii to gr. v with children, inducing and maintaining cinchonism as fully as possible, is thought to effect the arrest of plastic exudation. Bromides, by their elimination by the bronchial and faucial surfaces, no doubt exert a beneficent local effect in addition to their efficacy as antispasmodics in controlling the laryngeal spasms. The bromide of ammonium is given the preference, and is recommended in full doses in alternation with quinia.

Chloral hydrate is believed by the author to have proven itself more efficacious in the treatment of croup than any other individual remedy. For seven years it has been freely used in every case treated by him, with much better results than had hitherto been obtained without its use. In eight cases since 1876, of such gravity as is usually thought to demand tracheotomy, six, by its persistent use, terminated in recovery; and in no single instance since its introduction has resort to this formidable operation been thought advisable.

The spasmodic affection of the larynx, which constitutes so dangerous a complication in this disease, is so perfectly controlled by chloral as to be almost eliminated from its dangerous symptoms. This effect might reasonably be expected from its well established efficacy in other spasmodic affections.

It will be observed that chlorine is an element in all the reputed antiplastic remedies employed in croup, and from the immense amount of this element employed in the manufacture of chloral, it might on this ground reasonably be supposed to be superior to them all. Having already, when presenting its claims to specific action in diphtheria, shown its effects upon the blood to preserve its fluidity and to prevent or arrest the tendency to fibrinous coagulation or exudation, it is sufficient in the present case to refer the reader to that part of this volume, with the remark that its therapeutic efficacy in croup is believed to be as rational and as well established as in that disease.

It is believed its use in the treatment of croup originated with the writer about the time of its introduction by him in the treatment of diphtheria, and so far as known, Prof. Bartholow alone among standard authors, has arrived at similar views, or commended its use in this disease. He says (Practice of Medicine, p. 437), "Besides the agents above advised, quinia and the bromides—for the laryngeal spasms chloral is to be commended. The author has preferred to give chloral and bromide of ammonium together, and the quinia separately. Besides its power to allay spasms, chloral is one of the few remedies which possess the property to check the formation of an exudation."

To assure its greatest efficiency, it should not only be given early in the disease, but should be given freely and persistently. To a patient two or three years old either of the formulæ, 23 or 24, may be employed in appropriate doses every hour or oftener when awake. For older patients the dose should be proportionately large, and in any case increased or diminished according to circumstances, special reference being had to the soporific effects of the chloral. If the tendency to sleep is strong, a less dose is indicated. Its employment does not in any way interfere with the administration of emetics when indicated, nor with any other measures deemed necessary.

Moist air being more easily respired in this disease than dry, it is advised that the atmosphere inhaled by the patient be impregnated with steam, either alone or medicated. Chloral and lime in the form of vapor or spray is regarded the most important. An eligible and economical mode of supplying the vapor consists in slaking lumps of fresh lime in an open-mouthed bottle, or in a coffee-pot closely covered and rendered tight by placing wet cambric beneath the lid, and so held as to compel the patient to inhale the vapor as it arises or is discharged from the spout, or rubber tube attached. A coffee-pot, or any similar vessel, with the spout placed near the top, is to be preferred, as it furnishes a more dense vapor, which can be easily directed to the nostrils of the patient. The water used for slaking the lime should contain from ten to twenty grains of chloral hydrate dissolved in each pint. The vapor may be made aromatic by adding to the water a small quantity of some agreeable perfume. The inhalations should be commenced as soon as the disease is recognized, and continued as long as the hoarseness persists. Each inhalation should continue ten to fifteen minutes, and should be repeated every hour or oftener in the early stages, and less frequently as the disease subsides.

No case of croup can be efficiently treated so as to afford the patient the best chance of recovery, without resort being had to inhalations of either the above or similar vapors, or of atomized fluids possessing like qualities. The old method of slaking lime in open vessels, thus filling the sick-room with the vapor, is both awkward and wasteful, as well as disagreeable and dangerous to the attendants, rendering them exceedingly liable to take cold upon going into the open air.

Spray inhalations, though believed to be less efficacious, may be used instead of the above. Those of lime-water and chloral, separate or combined, the author considers most efficacious. (Nos. 10, 11, *et seq.*)

For use in this way Mackenzie recommends lactic acid (16).

J. Lewis Smith recommends the nearly constant use of lime-water four parts, and glycerine one part, only intermitting its use every second hour long enough to inhale one ounce of No. 14.

When portions of false membranes are thought to be loose, or the passages are greatly obstructed by mucus, prompt emetics are indicated, and if not successful in dislodging and expelling the obstructing matter, recourse may be had to the use of a small soft probang or brush for the purpose.

The local application of cold water and of ice have been advised, but are uncomfortable to the patient, and hence resisted by him, and opposed by the attendant friends as being a harsh and hurtful expedient.

Emollients rendered antiseptic, as glycerine with chloral hydrate (grs. v to x in ℥ i), or camphorated oil, or light warm linseed poultices, are preferred by the writer, and are recommended.

The patient should be well nourished, and allowed agreeable beverages. Milk and beef juice or essence, with soft farinaceous preparations, as panada, arrowroot, cornstarch, &c., with custards and syrups, may be given according to the judgment of the practitioner and the taste of the patient.

Finally, the grave question of *tracheotomy* may be forced upon the attendant physician from the apparent failure of the timely and persistent use of the best remedies at his command; for it is certain that this grave issue must occasionally be faced, despite the important addition of chloral to the therapeutics of this dangerous disease. The indications that call for the performance of this operation are solely such as relate to the respiration. In brief, it is necessary and justifiable after all other remedies have failed, and impending suffocation can only be averted by making an artificial aperture into the windpipe in order to render respiration possible. This procedure, surely to be followed by the death of a large majority of its subjects, can never be justified upon the plea of conservation, in order to forestall and anticipate dangers which either may or may not occur, but only, as it were, in the presence of death itself, with all it implies. Since using the chloral treatment I have witnessed a larger proportion of recoveries from conditions usually thought to demand the operation, but in which it was not performed, than is shown by the most favorable statistics to have resulted from its performance. Six out of eight such cases I have seen recover from the use of therapeutical measures alone, while the best results obtained in the best institutions, by the most experienced and skillful surgeons, in this country and Europe, scarcely average a single recovery in less than five cases operated upon. Between the years 1849 and 1858, according to Trousseau, 466 cases operated on in the Children's Hospital in Paris, 126 recovered, and 340 died. In 1863, so far as ascertained by careful research, the proportion of recoveries at the Hospital des Enfants Malades, was one in four; at the Hospital Sainte Eugenie, one in six. In the latter, from 1854 to 1875 inclusive, one in four and fifty-four hundredths, and in the former, from 1851 to 1875 inclusive, one in three and eighty-two hundredths. The statistics of Paris probably represent the best results attainable by this operation in croup by the most skillful and experienced operators.

In England and America the results are not known to be more encouraging; practically they are identical and hence need not be repeated.

We repeat then, only the gravest conditions can justify so equivocal a procedure. The conditions demanding and justifying such an operation are those relating to the degree of laryngeal obstruction. It is manifest that occlusion of the trachea below the point of operation, or of the bronchi, not only could not be remedied by tracheotomy, but contraindicate its performance. The degree of laryngeal obstruction is indicated by the greater or less respiratory stridor, and is still further evinced by being accompanied by evidences of insufficient aeration of the blood, as blueness or lividity of the lips and finger tips. When such evidences of asphyxia exist and can in no other way be relieved, then it is clearly time to have recourse to tracheotomy. To delay in the presence of these portentous symptoms is even more dangerous than the operation. Therefore it is now clearly a duty to open a passage for respiration, or it must cease.

It is advisable that this extremity, which may occur suddenly and unexpectedly, should be anticipated by careful preparation for prompt action. Have in readiness one or more double canulæ, in addition to the instruments for making the incision, which are usually found in every surgeon's pocket case. Every physician liable to be called upon to perform the operation is supposed to have familiarized himself with its details, its dangers, and subsequent management, by a knowledge of the teachings of the best surgical authors.

For succinct advice and directions regarding this procedure (tracheotomy), attention is likewise called to chapter XXIII, which has been kindly furnished for this volume by an able, skillful, and experienced operator, R. A. Vance, A. M., M. D., late Professor of Operative Surgery and Clinical Surgery in the Medical Department of the University of Wooster.

CHAPTER XXIII.

TRACHEOTOMY.

BY R. A. VANCE, A. M., M. D.

Systematic writers describe three operations for the relief of obstructive disease of the air-passages — laryngotomy, laryngo-tracheotomy and tracheotomy. In laryngotomy the opening is made through the crico-thyroid membrane. Laryngo-tracheotomy involves an incision into the crico-thyroid membrane primarily, followed by section of the cricoid cartilage and adjacent rings of the trachea. In tracheotomy the surgeon opens the trachea by a vertical incision in the middle line of the neck. There is no department of surgery in which more erroneous notions prevail than in that which pertains to operations upon the windpipe. These errors relate not only to the supposed facility with which the air-passages can be opened, but extend even to the *regions* in which the operation should be performed. Thus, laryngotomy and laryngo-tracheotomy have been extolled as measures adapted for the relief of suffocative angina, whether catarrhal, croupous or diphtheritic. Anyone versed in anatomy knows that laryngotomy and laryngo-tracheotomy can be readily performed in the adult. The experienced surgeon shrinks from their execution under any circumstances owing to the dangers that attend and follow them. Any interference with the structures of the larynx may develop distressing spasm of the glottis, or initiate fatal inflammation: in patients fortunate enough to escape the immediate dangers of these procedures, necrosis of the laryngeal cartilages frequently ensues, while permanent impairment of the voice is an almost inevitable consequence in those who recover. The readiness, with which laryngotomy and laryngo-tracheotomy can be performed upon the adult has originated an idea that these measures can be effected with equal facility upon the child. That they *can* be performed, even upon an infant, no one denies — that they can be *easily* executed in a child, no one who has attempted either procedure, even upon the cadaver, will maintain. The small size and rigid walls of the air-passage at the points where it must be opened, as well as the difficulties attendant upon the performance of these operations and the dangers associated with them, should prevent laryngotomy, or laryngo-tracheotomy being resorted to for the relief of suffocative angina.

Tracheotomy is the operation that, as a rule, should be resorted to in such cases. But even this procedure has not escaped misrepresentation. Some years since a distinguished physician, the Professor of Practice in the University of Louisville, spoke of tracheotomy as the most simple thing in the world, which anyone might perform easily with a razor! Well might Dr. S. D. Gross say, that, had this gentleman ever opened the trachea he would never have made such an erroneous statement; and add — "the amputation of a limb, the extirpation of a glandular tumor, lithotomy and even the perineal section are trifling matters in comparison with tracheotomy in a short, thick-necked and restive child." To such statements as the one reprobated by Dr. Gross, the sacrifice of many lives and the humiliation of many operators are due. The erroneous impression that tracheotomy is not difficult, that little anatomical knowledge, and no surgical experience is demanded for its performance, has led many an inexperienced practitioner to attempt the opening of the wind-pipe — attempts that but too frequently have cut short the patient's life and injured the reputation of the physician.

Various complicated appliances have at different times been recommended as mechanical devices that would rid this operation of danger and render its execution easy. It is needless to spend time in their enumeration, for, to the inexperienced operator they would be a snare: to the experienced surgeon they would be useless. A knowledge ot anatomy and a reasonable degree of surgical skill are all that are demanded for tracheotomy: the experienced surgeon can open the trachea successfully with no other implements than a sharp knife, and such other aids as can be improvised at a moment's notice in any house. Retractors, tenacula, artery forceps, scalpel, sharp and blunt-pointed bistouries, and tracheotomy tubes, comprise an outfit that supplies the surgeon with all the instruments he will be likely to need in the vast majority of cases.

The use of anæsthetics in the operation is a question to be decided by no hard and fast rule, but a problem to be solved independently for each individual case. The duration of the disease, the condition of the respiration and circulation, the general state of the patient, and the wishes of the individual to be operated upon, are all elements to be taken into consideration in arriving at a decision. It can be stated emphatically, however, that the pain of the operation is slight, and that by employing local anæsthesia, or simply benumbing the skin over the trachea with ice, even this suffering can be materially reduced. The objections to ether or chloroform in suffocative angina are very great.

In order to open the wind-pipe satisfactorily, the light must be good, and the patient properly placed with reference to it, in the supine posture, and should have his shoulders supported by one pillow, his head by another, and his neck made prominent by a hard roll of cloth between the two. In adults it is occasionally desirable to operate with the patient in a sitting position—the patient should then support his head on the back of the chair. The assistant who is subsequently to have charge of the sponges now uses the ether spray, or ice, and benumbs the integument over the point where the trachea is to be opened. This done, the surgeon, who stands behind the patient, if sitting, or at his right side, if in the recumbent position, steadies the integument with the fingers of the left hand, and makes an incision through the skin an inch and a half, or two inches long, the center of the cut resting over the third tracheal ring. This incision is carried down until the fibrous bands uniting the muscles on either side of the mesial line are exposed. Any blood-vessels exposed in the procedure are either drawn to one side, or ligated at two points and cut between. A few strokes of the knife loosen the central attachments of the muscles, and permit them to be drawn aside. The handle of the scalpel may now clear the anterior surface of the trachea of all overlying structures save the layer of firm fascia in immediate contact with it. If the thymus gland projects upward, it can be drawn down; if the thyroid isthmus projects downward, it can be drawn up; vessels can be pulled to one side — in a word any structure the surgeon does not wish to cut can be loosened and removed out of the way. The fascia covering the trachea should now be incised, the latter is thus exposed, and if the subsequent incisions have all been made the length of the original opening in the skin, and the hemorrhage has ceased, the surgeon is ready to open the wind-pipe. In order to do this, the trachea is steadied with a tenaculum, and one ring cut through with a sharp-pointed curved bistoury; a blunt-pointed bistoury is passed through the opening, and the incision enlarged to a degree sufficient to admit the tracheotomy tube — if no tube be at hand an elliptical piece is cut from the anterior portion of the trachea and pains taken to keep the edges of the wound widely separated by some kind of improvised retractors as wire bent to suitable shape. If a tube is to be inserted, so soon as the opening in the trachea has been enlarged to a sufficient extent, the surgeon passes his finger into the trachea, and at once follows it with the tracheotomy tube, the finger serving as a guide to pilot the tube into the air-passage. Should the patient be able to breathe through the tube, all that remains to be done in ordinary cases is to fasten the flanges of the outer tube around the neck by means of tapes, and give directions for the after treatment.

The incision into the trachea should be of such a size as to fit snugly the tube when the latter is in place. Inasmuch as the opening in the skin is much longer than that in the wind-pipe, it may be necessary to .draw the edges of the latter together with sutures after the tube is introduced. Yet I have not always found this good practice: on the contrary, if the parts between the trachea and flange of the canula be filled with absorbent cotton, it will serve a threefold purpose — hemorrhage will be guarded against; the wound will be protected from the irritating influence of the tracheal discharge; and the opening into the wind-pipe will be the sooner consolidated to such an extent as to permit the removal of the tracheotomy tube. It generally takes three days for the wound to assume such a state that it remains patent when the tube is withdrawn. During this time the outer tube should not be disturbed; if accidentally displaced, the surgeon himself should return it. The inner tube can be removed for cleansing at any time it may seem necessary, and this duty can be performed by the nurse. When the trachea is opened the patient generally struggles for air — the insertion of the tube and change of the patient's position afford relief. In a short time tracheal mucus of an adhesive stringy character begins to be voided. After a while it may accumulate to such a degree that even frequent removals of the inner tube no longer suffice to keep the passage-way clear: in these cases, in addition to washing the inner tube in hot water every fifteen minutes or so, the nurse will have to use feathers to extract the mucus that accumulates below the canula. In all cases where tracheotomy has been performed, surgical aid should be close at hand for the first two days after the operation. Immediately after the tube is introduced and it is seen that the patient breathes well, blankets may be hung about the bed in such manner as to isolate the patient and permit his being subjected to the action of steam without filling the whole room with aqueous vapor. The tube may have to be taken away before the wound has had time to consolidate; under such circumstances retractors must be used to keep the edges asunder until the opening is rendered patent by plastic material. For the first few days the patient's diet should consist of fluids: there is no objection, however, to the administration of such drugs as the physician may deem necessary for the proper medicinal treatment of the case.

CHAPTER XXIV.

PLASTIC BRONCHITIS.

Plastic Bronchitis, denominated also fibrinous bronchitis, croupous bronchitis, &c., is a distinct disease which is believed to have its seat primarily in the bronchi of the third and fourth order. Its remarkable and diagnostic feature is the formation, or, rather, exudation, upon the interior of the air passages, below the trachea, of a membrane in character identical with that described in pseudo-membranous laryngitis as located upon the walls of the larynx; and in diphtheria, in the pharynx and elsewhere. These diseases, although very diverse in their other characteristics, exhibit by this similarity, a relationship which is at least very suggestive in regard to their classification and therapeutic management. On account of the identity of the membranes, Sir John Rose Cormack "suggested that plastic bronchitis may be a variety of diphtheria"; and numerous writers of great distinction, Mackenzie with others, for the same reason, teach that croup is truly and only laryngeal diphtheria; while Niemeyer has called it bronchial croup. Such doctrines indicate the recognized relationship, based on the plastic phenomenon, common to each of these diseases; which, however, is quite insufficient, as shown in the previous pages of this work, to establish their identity; their distinctive features are too numerous, uniform, and emphatic to be reconcilable with such an idea. In systems of nosology, however, classes are formed upon analogies less apparent, and no good reason exists why these three distinct diseases, thus related, should not be grouped as a separate class, to be denominated *Membranous diseases.*

The class thus formed, though small, is second to none in importance, and this *last* of the series, although much less common, is hardly less grave than its predecessors.

It is observed both as an acute and chronic affection; most frequently in young adults, although no period of life is known to be entirely exempt.

Niemeyer mentions the case of a girl fifteen years old who had almost daily, for years, coughed up almost a complete cast of the left bronchial tree.

Causes. Of the causes of plastic bronchitis we know as little or less than is known of those of laryngeal croup. The type of the inflammation is thought to be similar in the two, as their products are identical, and also from the tendency of both to extend downward from their original sites, and the general absence of symptoms, except such as depend upon the local disease.

The more rapid progress of croup is thought to depend upon its location at the fountain head of the respiratory current, and upon the exquisite sensibility of the larynx, which cannot be made tolerant of the foreign body (the membrane) as are the lower air passages.

Inhalation of cold air, and bodily exposure we know aggravate the symptoms of this disease, but their influence in its causation can only be inferred. It is proper here to remark that the disease is neither contagious nor epidemic; and so rare as to afford little opportunity to investigate its nature or causes.

An idiosyncracy, or peculiar state of the blood, as causative agencies are suggested by the membranous deposits and its analogies to croup noted above.

Anatomical appearances. "In primary independent croupous bronchitis (i. e. plastic bronchitis) the same condition of the bronchial mucous membrane is found, and with the same coagulated exudation upon it, which we have described as existing upon the mucous membrane of the larynx in laryngeal croup. In the larger bronchi the caliber of the canal is not usually completely occluded; and the coagula are tubular; but in the smaller bronchi they form cylindrical plugs. Croupous bronchitis is seldom spread over the whole lung; generally it is partial, and confined to a small number of bronchi; but to this rule there are exceptions." (Niemeyer.)

The larynx and trachea, it is believed, are never involved as in croup and diphtheria.

Symptoms and diagnosis.—These, as before stated, depend largely upon the local disease; the constitutional perturbation, whatever it may be, is not declared by known phenomena except the exudation, the existence of which is only determinable by portions expectorated. If suspicious coagula appear in the sputa, they should be carefully rinsed in water and soaked in dilute acetic acid; if only condensed mucus they will shrink and be rendered firmer, and the case is ordinary bronchitis; if fibroid, they will swell and soften and indicate the plastic type.

Symptoms of acute inflammation, fever and pain, are generally slight or entirely absent. When, however, these exist continuously, with extreme dyspnœa, they indicate an extensive, acute, and very dangerous form of the disease that may terminate in fatal asphyxia.

More or less febrile action, however, is excited, even in chronic cases, by the violent and prolonged cough and labored breathing attendant upon the separation of masses of the exudation; which, with the cough, quickly subsides when the mass is expectorated. Bloody sputa, more or less abundant, often precedes and generally follows, for a few days, these occasions; during which the cough and dyspnœa increase to fearful violence, and the patient appears in the greatest danger of suffocation.

When the affection is acute, the casts are quickly renewed, and the course of the disease is limited to a few weeks at most, and is said to prove fatal in about fifty per cent. of the entire number of cases.

In the chronic form the casts are also often reproduced and the affection may continue for years with but little danger to life.

The membranous casts when expectorated, may be in convoluted masses or in the form of branching tubes with clean cut edges, or as solid branching rods if formed in the bronchi of finer caliber. When expectorated in masses, if placed in water and unfolded, they exhibit most interesting models of portions of the bronchial tree; the trunk being sometimes from a tube of the third or fourth degree, with branches diminishing in size with the successive divisions, to mere capillaries.

The patients generally suffer from dyspnœa in proportion to the extent of the obstruction. The respirations are quickened from the same cause and in the same ratio. Cyanosis is apparent at times, due to the imperfect aeration.

The cough, except about the periods of expulsion of membranes, is dry and harassing.

Auscultation and percussion furnish almost no aid in the diagnosis of fibroid bronchitis and are of as little service in its treatment. So long as the bronchial obstruction is *complete* the respiratory murmur is destroyed over the pulmonary area deprived of respiration; and enfeebled if the obstruction be only partial.

Partial bronchial obstruction, according to its degree, also occasions correspondingly varying sibilant sounds. A coarse flapping *rale* is observed sometimes, and attributed to partially detached membranes fluttered by the respiratory currents.

The resonance on percussion and the vocal fremitus are not noticeably changed, except from collapse of the lung substance; or from solidification from localized pneumonia, which sometimes happens, and in either case more or less dullness is occasioned. In diagnosis none of these sounds are at all distinctive until after their significance has been shown by the expectoration of fibrinous clots or casts.

The respiratory movements of the chest are perceptibly diminished if the obstruction cuts off a due supply of air from any considerable portion of the lungs. This is only perceptible upon one side, when the disease, as is common, is limited to one lung.

The most frequent *complications* of plastic bronchitis are phthisis and pneumonia, which reveal themselves by the superaddition of their appropriate well known symptoms.

Treatment. The recognized analogy of fibrinous bronchitis to croup, has led, as might be expected, to a corresponding similarity of medical treatment. "The treatment is to be conducted upon the principles laid down for the management of laryngeal croup." (Niemeyer.) To effect the speedy separation and expectoration of the casts, the inhalation of warm steam is regarded as of undoubted utility, as are also vapors or sprays containing chloral hydrate (℞. 9, 10, 11), lactic acid (℞.16), or lime (℞.18). The vapor of lime and chloral (℞.17), is recommended.

Emetics are also used when the obstruction has become considerable, to promote the dislodgment and expulsion of the casts. Those advised for croup are especially appropriate. (See croup.)

"Rugel and other German authors recommend especially the muriate of apomorphia as an especially appropriate emetic in consequence of the promptness of its operation with but little nausea, and the absence of unpleasant after effects."

(Flint, see also Ziemsen's Cyclopedia, vol. 4, p. 467.) In this country it is rarely employed, and, on account of the dangerous depression sometimes following its exhibition and the difficulty of preserving it, it is not to be recommended. The mechanical emetics, *i. e.* the sulphates of copper and zinc, yellow sulphate of mercury, alum and mustard are equally prompt and more safe, and therefore preferable.

"Aside from the treatment having immediate reference to the removal of the casts, measures for the relief of the bronchitis are indicated. For this object the *iodide* of *potassium* has been found especially useful." (Flint.) "I have never observed any benefit resulting from its action in this disorder." (Niemeyer.) "This remedy is said to have been employed with success." (Prof. A. T. H. Waters, Liverpool.)

I have used iodide of potash faithfully in a chronic case of this anomalous affection, without being able to discover any beneficial effect. The same case, when later put upon arsenic, iron and cod-liver oil, convalesced and complete recovery resulted, though not speedily.

Admitting the importance of those measures of treatment to effect the separation and expulsion of the casts, and all such also as are employed "for the relief of the bronchitis," and these embrace all measures of acknowledged efficacy in other forms of bronchitis, it is observed that writers on this affection are quite as conspicuous by the omission of all reference to a possible primary constitutional implication, as by the constant suggestion, if not positive affirmation that the disease is of local origin; a partial or limited, specific form of bronchial inflammation.

The question, Is the disease a specific form of inflammation, or, the result of constitutional causes? although apparently overlooked, cannot be ignored by the thoughtful clinician. This much can be positively affirmed :—the *ordinary* causes of bronchial inflammation do not induce fibroid exudation; else this phenomenon would be as common as other types of bronchitis. If the affection be then a specific form of local bronchitis, not from *ordinary* causes, yet as it probably does not exist without cause, that cause must be special; and from its infrequency, is most likely personal and systemic. Such exceptional manifestations are no doubt connected with, or caused by, a constitutional vice, or, what amounts to the same thing, a disordered state of the blood. This view is further confirmed by the almost uniformly pale and cachectic appearance of the patients (at times cyanotic from imperfect breathing): and, its acceptance by writers may also be argued from the use of such constitutional remedies as iodide of potash, arsenic, iron and cod-liver oil.

None of the remedies employed for the cure of this disease are known to possess aplastic properties, or efficacy in antagonizing in the blood, the tendency to part with its fibrine, so clearly exhibited in this and the other membranous diseases. Certainly *one* of the clear indications of treatment, is to correct the constitutional affection by such remedies as "are known to possess the power to limit or prevent an exudation."

At the head of this class of remedies we place *chloral hydrate*, either alone or conjoined with *bromide of ammonium* or *chlorate of potassium*, substantially as shown in ℞. 22, 23. These remedies are advised, in plastic bronchitis, mostly on theoretical grounds; no sufficient opportunities having occurred to the writer, since the introduction of the chloral treatment, to fully test their efficacy in typical cases of this disease, as has been done in diphtheria and croup. In chronic forms of disease, there is manifestly no occasion to push these remedies as advised in acute forms, in which the progress is rapid and the perils immediate.

Ample *nutrition* is a part of the treatment of every case of plastic bronchitis, not to be overlooked, nor considered of secondary importance.

FORMULÆ.

The formulæ here given may be variously altered to adapt them to various ages, degrees of violence, and stages of disease, and to the tastes, susceptibilities and tolerance of patients, and the judgment of the practitioner. It is believed, however, that in the main they will, as written, meet the indications for their use.

They are not all original, but have been gleaned from various authentic sources, and are not presumed to represent all the remedies needed in the treatment of the membranous diseases.

Local Remedies.

1.

℞. Pot.Permanganat.	gr. x *a* xx.	
Aquæ	℥ i.	*M.*

Useful in gangrene, &c.

Apply to fauces with large camel's hair brush.

For atomizer reduce ½.

2.

℞. Chloral Hyd.	ʒ ss *a* ʒ iss.	
Sir. Cort. Aurant.	℥ ss.	
Aquæ	℥ i.	*M.*

Or,

3.

℞. Sol. Chlor. Hyd. (gr. 40 to ℥ i)	℥ ss.	
Tr. Iodin. C.	ʒ iii.	
Glycerin.	℥ ss.	
Aq. Menth. Pip.	*ad* ℥ ij.	*M.*

For use as No. 1 in fauces, for effect upon false membrane and disinfection.

4.

℞. Chlor. Hyd.	ʒ i.	
Tr. Iodin. C.	℥ i.	
Glycerin.		
Aquæ	*aa* ℥ ss.	***M.***

Or,

5.

℞. Chloral Hyd.	ʒ i.	
Tr. Iodin. C.		
Glycerin.		
Tr. Gaulth.		
Aquæ	*aa* ℥ ss.	***M.***

For external use in glandular and other swellings.—Apply 4 times a day, and keep the parts well covered with dry, soft flannel.

6.

℞. Chloral Hyd.	gr. x *a* xxx.
Spt. Gaulth.	ʒ i. *M.*

Or,

7.

℞. Chloral Hyd.	gr. x *a* xxx.
Sol. Sod. Borac.(gr. x *a* ʒ i)	
Aq. Menth. Pip.	*aa* ℥ ij. *M.*

For injecting into nasal passages to cleanse and disinfect.

Or,

8.

℞. Acid. Carbol.	gtt. xxiv.
Glycerin.	℥ ij.
Aquæ	℥ vi. *M.*

For Atomizing.

9.

℞. Pot. Permang.	gr. v.
Aquæ	℥ i. *M.*

To be used in atomizer for disinfecting. Instead of the Pot. Permang. in 9, use, if preferred, 5 grains each of Chloral Hyd. and Pot. Chlor.

10.

℞. Chlor. Hyd.	gr. x.
Spt. Gaulth.	ʒ i.
Aq. Pur.	
Aq. Calc.	*aa* ℥ iss. *M.*

Or,

℞. Chlor, Hyd.	gr. x.
Acid. Carbol.	gr. xv.
Aq. Calc.	
Aq. Gaulth.	*aa* ℥ iii. *M.*

Or,

11.

℞. Ammon. Brom.	
Potas. Brom.	*aa* gr. v *a* x.
Aquæ	℥ iss. *M.*

The last three useful in laryngeal diphtheria and croup, every 1, 2, 3 or 4 hours for 15 minutes.

12.

℞. Acid. Salicyl.	
Sod. Borac.	*aa* gr. v.
Aquæ	℥ i. *M.*

Or,

13.

℞. Acid. Salicyl.	ʒ ss.
Glycerin.	℥ ij.
Aq. Calc.	℥ iii. *M.*

Or,

14.

℞. Acid. Carbol.	gtt. xxii.
Glycerin.	℥ ij.
Aquæ	℥ vi. *M.*

Or,

15.

℞. Acid. Carbol.	gtt. xxii.
Pot. Chlorat.	ʒ iii.
Glycerin.	℥ iii.
Aquæ	℥ v. *M.*

Or,

16.

℞. Acid. Lactic.	gr. xx.
Aquæ	℥ i. *M.*

Recommended also in laryngeal diphtheria and croup.

The following are appropriate quantities of the medicines named for each ounce of water for *spray inhalations*.

Many other medicines and various combinations are also employed in this manner, as the judgment of the practitioner or accredited authorities may indicate.

If a hand ball atomizer, which, when well constructed, answers every purpose, is employed, let the fluid be warmed to 100° F. or upwards.

Acid. Tannic.	gr. iii *a* v.
" Lactic.	gr. xx.
" Carbol.	gr. iii.
Ammonium Brom.	gr. v *a* x.
Aq. Calc. (undiluted)	
Chloral Hyd.	gr. v.
Fer. Perchlor.	gr. iii.
" Sulph.	gr. iii.
Potas. Permanganas.	gr. v.
" Chloras.	gr. xx.
" Bromidum	gr. xv.

Vapor Inhalations.

17.

℞. Fresh Lime	℔ i.
Water containing Chloral Hyd. ʒ i	O. i.

Or,

18.

℞. Fresh Lime	℔ i.
Water	O. i.

Put the lime in lumps into a coffee-pot, open mouthed bottle or fruit jar, pour upon it the fluid (to the spout of the coffee-pot or similarly constructed vessel may be attached a piece of rubber tubing of convenient length when desired), and when the vapor begins to rise direct it into the patient's face so it must be freely inspired; use every hour in laryngeal cases and croup. *Of inestimable value.*

General Remedies.

19.

℞, Pot. Chlorat.	ʒ ij.
Ammon. Mur.	ʒ i.
Glycerin.	℥ ij.
Aquæ	℥ vi. *M.*

Given in cases of croup, &c., in one or two drachm doses every hour, according to age.

20.

℞. Quin. Sulphat.	ʒ ss.
Elix. Tarax. C.	℥ ij. *M.*

Dose, teaspoonful every two hours for a child of 5 years, and alternated with

21.

℞. Tr. Fer. Chlor.	ʒ ij.
Pot. Chlorat.	ʒ ij.
Sir. Simp.	℥ iv. *M.*

Dose, same as 20.

Prof. Smith declares this in his hands "the most satisfactory treatment" in diphtheria.

22.

℞. Chloral Hyd.	
Pot. Chlorat.	*aa* gr. xcvi.
Spt. Gaulth. vel.	
Spt. Menth. Pip.	ʒ i.
Aquæ	
Sir. Simp.	*aa* ℥ ij. *M.*

Of great value in diphtheria. Dose for an adult two teaspoonfuls every hour when awake.

No drink to follow the administration for 8 or 10 minutes. The degree of somnolence is somewhat a measure of the effect of chloral, and should influence accordingly.

The pungency of this and the following Chloral mixtures should, by varying their strength, be adapted to the different faucial sensibility of patients, which can be judged by the complaint, if any, of pain following the administration.

23.

℞. Chloral Hyd.
Pot. Chlorat. *aa* gr. xlviii.
Spt. Gaulth. vel.
Spt. Menth. Pip. ʒ i.
Sir. Simp.
Aquæ *aa* ℥ ij. *M.*

Give a teaspoonful or teaspoonful and a half every hour when awake to a child from 5 to 10 years of age.

See also remarks under ℞. 22.

24.

℞. Chloral Hyd.
Ammon. Brom. *aa* gr. lxxx.
Spts. Chloroform. ʒ i *a* ij.
Sir. Simp.
Aquæ *aa* ℥ ij. *M.*

Give to adults two teaspoonfuls every hour, and to children above 10 yrs. one, in laryngeal diphtheria and croup.

For younger children use the following:

25.

℞. Chloral Hyd.
Ammon. Brom. *aa* gr. l.
Spts. Chloroform. ʒ i *a* ij.
Sir. Simp.
Aquæ *aa* ℥ ij. *M.*

Give a teaspoonful every hour when awake.

These are cases of the gravest danger, and demand the utmost vigilance in the use of both local and general treatment.

26.

℞. Sod. Sulphocarb. ʒ ij.
Sir. Simp.
Aquæ *aa* ℥ i. *M.*

For a child of five years, teaspoonful every 3 hours.

27.

℞. Pilocarpin. gr. ⅛ *a* ⅔.
Pepsin. gr. i *a* i¼.
Acid. Hydrochlor. gtt. ij.
Aquæ ℥ ijss.
M.

Give a teaspoonful hourly to children.

28.

℞. Pilocarpin. gr. iss.
Pepsin. gr. xxx.
Acid. Hydrochlor. gtt. viii.
Aquæ ℥ ijss.
M.

Give a teaspoonful hourly to adults.

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